COMSAT

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INTERNATIONAL COMMUNICATIONS, INC.

COMSAT CONFIDENTIAL

FOREIGN BROADCAST INFORMATION SERVICE
CONUS EARTH TERMINAL

PART I
TECHNICAL AND MANAGEMENT PROPOSAL

A PROPOSAL

BY

COMSAT INTERNATIONAL COMMUNICATIONS, INC.
950 L'ENFANT PLAZA, S.W.
WASHINGTON, D.C. 20024

In Response To RFP-16-85

10 OCTOBER 1985

COMSAT

INTERNATIONAL
COMMUNICATIONS,
INC.

STAT
Vice President
Marketing & Sales

9 October 1985

STAT

Foreign Broadcast Information Service
P.O. Box 2604
Washington, D.C. 20013

RE: RFP-16-85

STAT

COMSAT International Communications, Incorporated (COMSAT International) is pleased to submit this proposal to the Foreign Broadcast Information Service for a Standard B, 15-meter CONUS earth terminal and associated services. Our proposal includes all the technical and management requirements to provide the United States portion of the INTERNET system as described in the RFP. Our proposal contains a basic system that responds directly to the RFP requirements. We have also proposed an optional equipment system which we believe will provide you more reliability and flexibility.

The Representations and Instruction documents have been completed, as requested, and are submitted as a part of our response. Our proposal, submitted separately bound in two parts, is valid for 90 days. We request that any extension of this offer be mutually agreed to by FBIS and COMSAT International, and confirmed in writing. Part 1 describes the technical and management elements of the service and Part 2 provides financial information and supporting cost data.

COMSAT International proposes that the earth station and microwave link for the transmission of additional circuits on a non-interference basis be **available for use by other COMSAT International customers. Such customer(s) would be approved by FBIS prior to COMSAT International proposing such usage.**

Should you have any questions about the proposal, please contact me or at (202) 863-6106. STAT

Yours truly,

STAT

Vice President
Marketing and Sales

950 L'Enfant Plaza, SW
Washington, DC 20024
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PREFACE

This proposal relies in part on information provided by the Foreign Broadcast Information Service in its RFP-16-85, dated 10 September 1985, the answers to questions given 25 September 1985, and on certain projections, including COMSAT International Communications, Inc., planned tariffs. Services provided under tariff by U.S. international carriers are subject to review and approval by the Federal Communications Commission.

Information contained within this proposal is to be considered confidential to the Foreign Broadcast Information Service and is to be used only in the evaluation of COMSAT International as the Contractor. Proposal information should not be disclosed outside the Foreign Broadcast Information Service except in the official evaluation of the proposal.

FOREIGN BROADCAST INFORMATION SERVICE
CONUS EARTH TERMINAL

PART 1
TECHNICAL AND MANAGEMENT PROPOSAL

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EXECUTIVE SUMMARY
FBIS EARTH STATION RESPONSE

COMSAT International Communications, Incorporated (COMSAT International) is pleased to respond to the Foreign Broadcast Information Service (FBIS) request for proposal dated September 10, 1985, for a 15-meter Standard B earth station to provide FBIS with integrated video, voice and facsimile communications (INTERNET) via an INTELSAT satellite located over the Atlantic Ocean.

COMSAT International Communications, Inc., is expert and experienced in earth station and antenna construction to operate in the INTELSAT global satellite system such as that required by FBIS. Seven earth stations in Micronesia and one in Santa Paula, California are all similar to the proposed FBIS facility and were designed, built, integrated and tested under the direction of the COMSAT International staff. COMSAT International has frequently been consulted by operating administrations throughout the world in matters relating to earth station implementation.

In response to the Request for Proposal (RFP), COMSAT International offers to construct the INTERNET earth terminal at the primary site at Quantico which will be in full compliance with the requirements of the RFP. The basic response which includes a 15-meter antenna and earth station equipment conforming to INTELSAT BG-28-74E (Rev. 1) will be capable of providing all the services specified in the RFP and will be expandable to carry additional services stated in the RFP. The equipment configuration proposed in the basic response

(except for modulators) is nonredundant. This is not customary COMSAT International practice where the customer's availability requirements compel full redundancy. It will, however, be adequate to meet the FBIS availability requirement of 99 percent. Nonetheless, we urge FBIS to consider carefully the full redundancy with enhancement option offered. With this option, the availability will improve to better than 99.98 percent.

This option provides a 15-meter antenna and a fully redundant equipment configuration for both the earth terminal and the terrestrial microwave link.

The options in our proposal are as follows:

Basic System: 15m antenna, nonredundant equipment (except modulator redundancy);

Options: 15m antenna, fully redundant equipment, 200 kW Diesel generator, 60 kW UPS and reflector and feed deicing.

Expanded INTERNET service in the future will require additional equipment. The earth station will be designed to accommodate this additional equipment and facilitate expanded services and service locations.

The COMSAT International proposal presents a detailed description of the earth terminal and the associated microwave terrestrial tail. This includes a detailed discussion of compliance with the performance requirements specified in both the RFP and in INTELSAT BG-28-74E (Rev. 1), as well as an analysis of the earth terminal design. Also included is a

satellite link analysis using typical operational parameters to provide a preliminary performance estimate.

The proposal contains detailed descriptions of the equipment to be integrated into both the FBIS INTERNET earth terminal and the microwave transmission link. The proposed facilities and the RFI environment at the Quantico site are discussed in detail. The latter is based on RFI data provided by FBIS since COMSAT was not afforded the opportunity to conduct RFI measurements at Quantico. These data indicate that shielding is not required to operate with the space segment leased by FBIS. This offer, therefore, does not include provision for shielding.

In the operation and maintenance section, we discuss the COMSAT International maintenance philosophy and the procedures which will be used for the operation and maintenance of the FBIS INTERNET earth terminal and the microwave link.

Finally, discussed in this proposal is the project management and administration as it will apply to the FBIS project. The management approach and techniques will be those which COMSAT has successfully developed and used over 20 years in the engineering and management of a large number of international and domestic satellite communications programs. To expedite the project and permit INTERNET operation to commence as soon as possible, the COMSAT International proposal will specify all equipment and facilities in advance of contract award. These specifications, upon approval by FBIS, will then provide the basis for all equipment procurement and facilities construction contracting.

COMSAT International believes that the award of the CONUS INTERNET earth terminal contract to COMSAT International will be of great benefit to FBIS. By combining earth segment responsibility with the existing space segment responsibility in one carrier will result in an efficient implementation and operation of the INTERNET system.

COMSAT International recommends that it provide complete system integration, operation and administration of this network's foreign terminals as well. Thus, COMSAT recommends that the construction and supervision of the foreign earth terminals in the United Kingdom and Panama, and later elsewhere, including O&M arrangements be performed by COMSAT International to have one U.S. international carrier responsible for the end-to-end FBIS service. This will maximize the efficiency of system operation, limit fault isolation problems and assure greater system integrity.

COMSAT International looks forward to discussing this proposal with you. Should there be any questions or clarifications required about any aspect of this proposal, please feel free to contact COMSAT International Communications, Inc., at your conveneince.

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1. INTRODUCTION

1.1 GENERAL OVERVIEW

COMSAT International has carefully reviewed the Foreign Broadcast Information Service (FBIS) Continental United States (CONUS) Earth Terminal RFP-16-85 and proposes to provide the CONUS Earth Terminal for the INTERNET system on a turn-key service basis.

The COMSAT International proposal for the INTERNET earth terminal complies with all requirements of the RFP. It includes a 15-meter antenna and the associated earth station equipment conforming to INTELSAT BG-28-74E (Rev. 1); it will be capable of providing the video link, a 60-kHz wideband channel, six 15-kHz voice channels and a single 3-kHz telephone channel; it is expandable to two video links, 20 voice grade 15-kHz channels and two wideband channels. All will meet the performance specifications given in the SOW.

In addition to the basic offering, an option has been included which, will provide superior reliability. This option is for a 15-meter antenna with a fully redundant equipment configuration. Initial results of an as yet incomplete system study indicates that with appropriate overseas earth terminals (estimated at 13-meters), the proposed Quantico station in combination with the leased space segment, will permit all the desired services to be provided at the specified performance levels.

COMSAT International's proposal includes a microwave transmission link between the INTERNET earth terminal and the FBIS headquarters at Rosslyn, Virginia. The basic offering is a microwave link with nonredundant equipment while the optional proposal includes full redundancy. This proposal also defines the baseband interfaces at the FBIS headquarters, and the required equipment to be located there.

The RFP specifies the Quantico Marine Base as the primary INTERNET terminal site. Accordingly, COMSAT International's proposal provides for situating the INTERNET earth station at the primary site at Quantico. Since COMSAT International was not afforded the opportunity to conduct radio frequency interference (RFI) measurements at the site, this proposal is based on analysis of the RFI data provided by FBIS. The data indicate that a berm is not required to operate with the transponder leased by FBIS. If subsequent measurements should reveal the need for shielding, site design changes will have to be made and costs will be affected. Similarly, since it was not possible to perform a detailed soil analysis at the proposed INTERNET earth terminal site, this proposal is based on the assumption that the allowable bearing pressure on the soil at foundation depth (24 inches below grade) is not less than 2000 PSF and that the soil is suitable for building highly stable structures without modification.

In summary, COMSAT International's proposal includes the following options:

a. Basic Proposal - 15-meter earth terminal at the Quantico primary site;

b. Option - 15-meter earth terminal with full redundancy at the Quantico primary site.

1.2 PROPOSAL OVERVIEW

This proposal is divided into 10 sections. Section 2 is devoted to the system design of the proposed earth station and to how it can meet the FBIS INTERNET requirements. In Section 3, the equipment and subsystems to be integrated into the FBIS earth station are described. The facilities and sites are discussed in Section 4. Details of the operation and maintenance are presented in Section 5. The station verification costs for testing are discussed in Section 6. The fully redundant equipment option for FBIS's consideration is summarized in Section 7. Section 8 contains a description of the project management organization, the compliance review and the schedule of task performance. The COMSAT corporate description is given in Section 9, and the representations, certifications and other statements of the offeror are in Section 10.

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2. SYSTEM DESIGN

2.1 GENERAL

In response to RFP-16-85, COMSAT International proposes to provide all necessary facilities and equipment, on a fully turn-key basis, to accommodate the following specified services:

a. One full motion analogue TV carrier with associated audio, the format could be NTSC, PAL, or SECAM.
b. One voice orderwire (FM/SCPC) channel.
c. Six full duplex wideband 15 kHz FM/SCPC channels.
d. One wideband 60 kHz (FM/SCPC) channel.

The facilities will include (a) an INTELSAT qualified Standard B station conforming to all requirements given in BG-28-74E (Rev. 1); (b) terrestrial microwave links to interconnect the earth station and FBIS headquarters in Rosslyn, Virginia. Initially, the microwave link will include the following:

a. One video link with associated audio
b. Six full duplex wideband 15 kHz channels
c. One 60 kHz wideband channel
d. One voice orderwire channel

A general overview of the satellite communications system being proposed for FBIS is presented in Figure 2-1. The earth station will be located on the Quantico Marine Base in the area of Independence Hill.

The proposed system includes a full duplex terrestrial microwave link interconnecting the FBIS headquarters at Rosslyn, Virginia, with the earth station at Quantico. This link consists of the following segments:

a. 23-GHz microwave link between FBIS, Rosslyn office and a repeater located on a building nearby. This segment will be approximately 500 feet long.
b. 18-GHz microwave link between the repeater in Rosslyn and a repeater located on a building in Alexandria.
c. 6-GHz microwave link between the repeater in Alexandria and a microwave tower at the earth station at Quantico.

The overall system performance will be a function of the U.S. earth station characteristics and those of the distant-end stations and of space segment parameters. To help FBIS in assessing system capabilities, representative link budgets have been prepared based on typical operational parameters. These are given in Section 2.3.

2.2 FUNCTIONAL DESCRIPTION

In this section functional descriptions of each of the major segments of the proposed system are given.

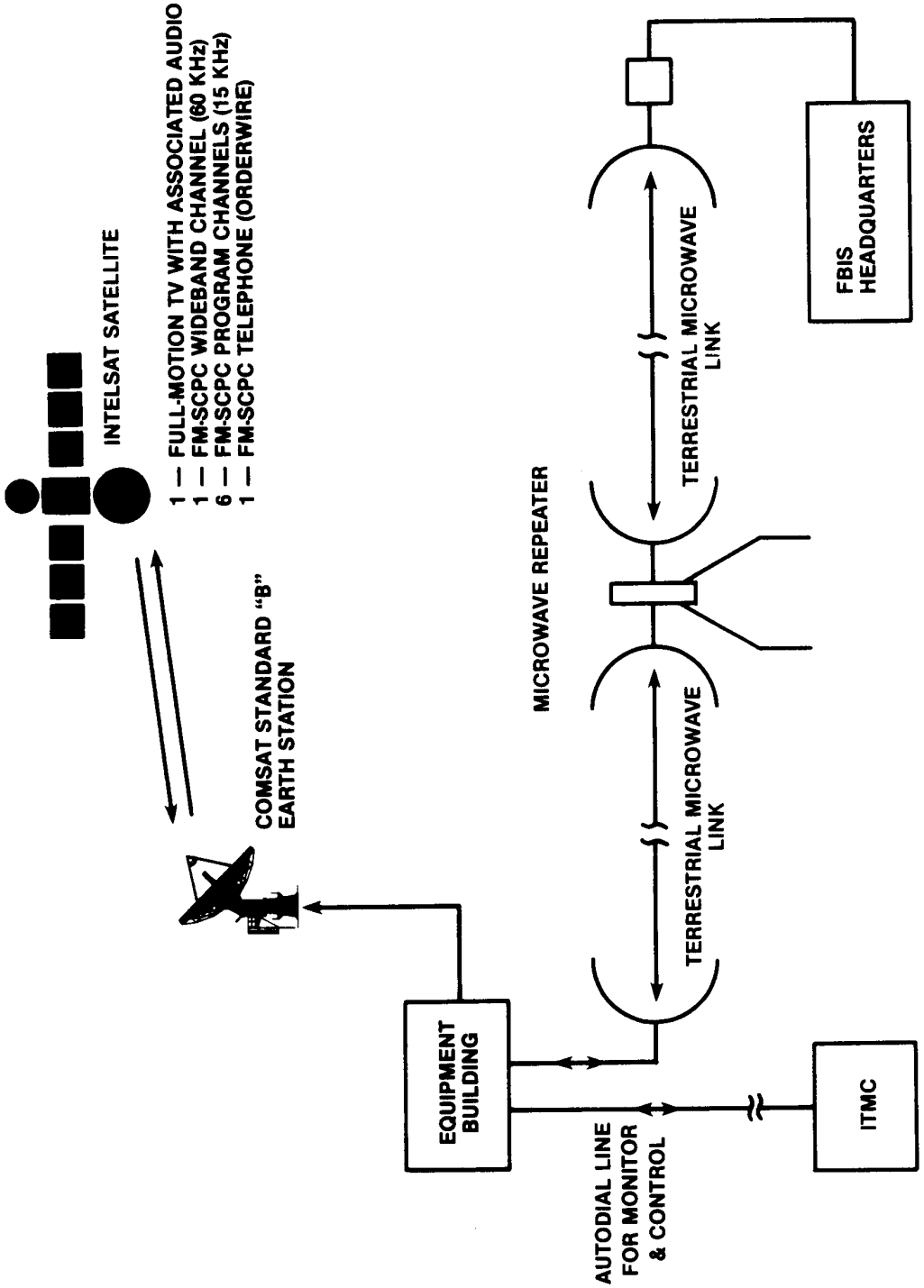


Figure 2-1. Satellite Communications System For Foreign Broadcast Information Service

2.2.1 TRANSMIT SUBSYSTEM

2.2.1.1 Terrestrial Microwave Transmit Link

The terrestrial transmit link consists of the microwave transmit subsystem at Rosslyn, transmit subsystems at the two repeaters.

The transmit subsystem at Rosslyn is illustrated in Figure 2-2. The 15-kHz program channels, the 60-kHz wideband channel, the orderwire channel, and the TV channel, with associated audio, will be routed through the patch panel and configured into two composite baseband signals using program channel modulators and service channel converters. The first composite baseband signal will consist of a TV channel with its associated audio and half of the other channels. The second composite baseband signal will consist of the remaining three 15-kHz channels, the 60-kHz wideband channel and one orderwire channel. Space has also been allocated on the second composite signal for the addition of a second TV channel with associated audio. Each composite baseband will then be frequency modulated onto a 70-MHz IF carrier prior to being up-converted to designated RF frequencies in the 23-GHz band. Power amplifiers at the output will provide the necessary gain and output power needed for microwave transmission. The two RF carriers will be combined and routed through low loss waveguide to the roof mounted antenna for transmission. Adequate fade margins are provided in the microwave link design to ensure reliable service.

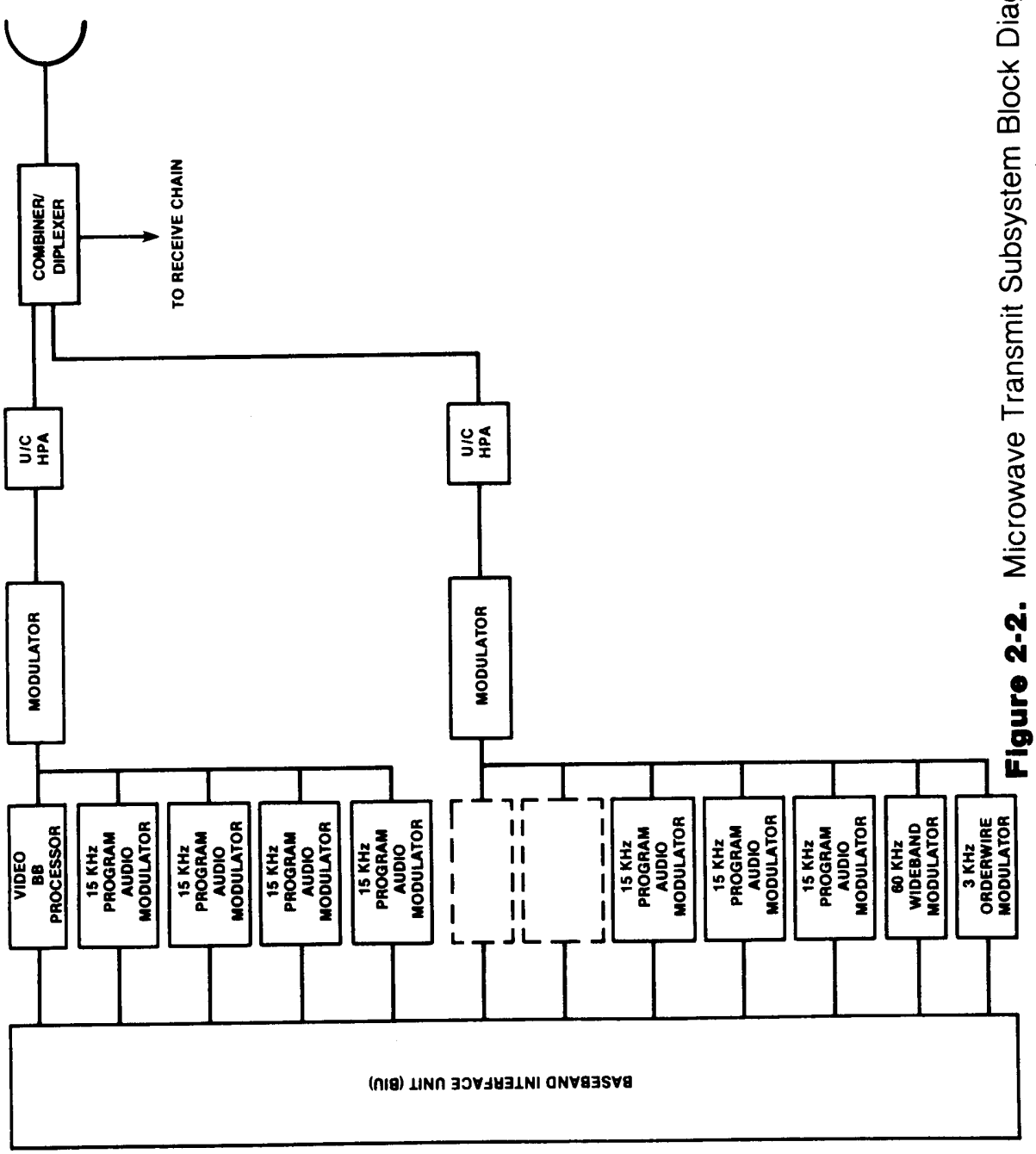


Figure 2-2. Microwave Transmit Subsystem Block Diagram

Two 70-MHz IF repeaters are proposed. At each repeater the signals received by the antenna will be amplified by low noise amplifiers and down-converted to an IF carrier. Automatic gain control (AGC) will be provided to compensate for any ~~lnoise amplifiers and down-convertered to an IF carrier.~~ Automatic gain control (AGC) will be provided to compensate for any level variations caused by the fadings in the microwave path. The IF carriers will then be up-converted to new RF frequencies and amplified prior to retransmission. This arrangement will eliminate any additional noise contribution thay may otherwise result from demodulation and remodulation of baseband signals.

In the first repeater, the RF carrier frequencies will be changed from the 23-GHz band to the 18-GHz band and in the second repeater the RF carrier frequencies will be converted from the 18-GHz band to the 6-GHz band.

The terrestrial microwave link will terminate at the earth station where a 6-GHz antenna mounted on top of a tower will feed the signals to the earth station transmit subsystem. Each individual channel will be demodulated back to the baseband frequency and will be routed to the earth station uplink via a patch panel.

2.2.1.2 Earth Station Transmit Subsystem

A block diagram of the earth station transmit subsystem is shown in Figure 2-3. A single channel per carrier modulation scheme will be used for transmission.

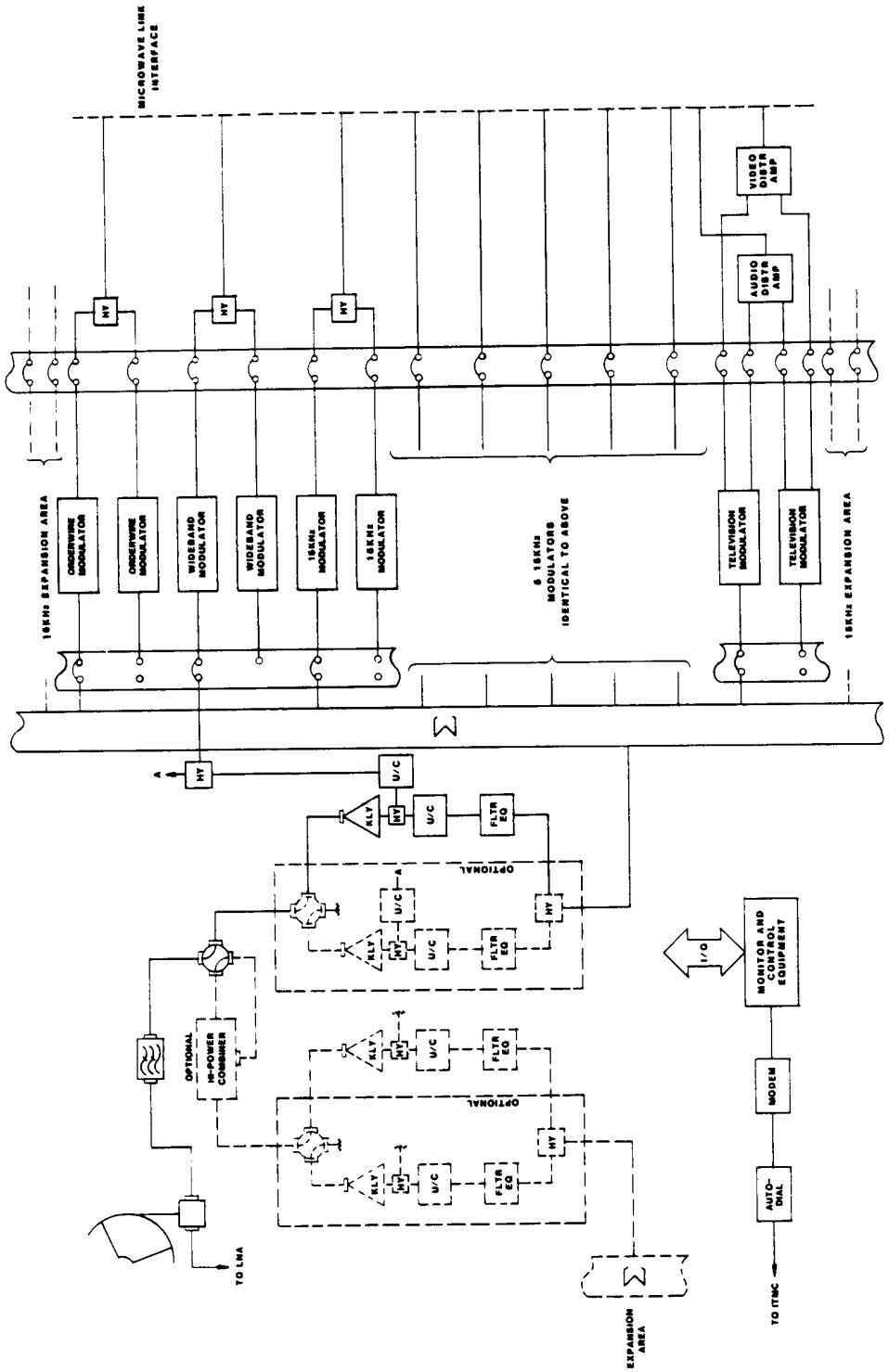


Figure 2-3. FBIS Earth Station Transmit Diagram

Each of the 15-kHz wideband channels, the TV channel with its associated audio, the orderwire channel and the 60-kHz channel will be individually frequency modulated onto separate IF carriers in the 52-88 MHz range. The modulated IF carriers will be combined and equalized prior to being up-converted to the assigned RF frequencies. Companders will be provided for each 15-kHz wideband channel and the orderwire channel for enhanced signal-to-noise performance. A standard INTELSAT 36-channel FM modulator and frequency synthesized up-converter with 125-kHz steps will be provided to carry the 60-kHz wideband channel. Standby modulators will be provided for each size carrier. The up-converted output of the modulated 60-kHz carrier and the output of the other up-converter containing the remaining carriers, will be combined and fed to the high power amplifier (HPA). The HPA will provide the necessary gain and transmit power to the antenna. Uplink power control for each carrier will be accomplished by a variable attenuator located at the output of each modulator. Overall transmit power control, in excess of 15 dB, will be provided by the gain control of the HPA. The HPA output will be routed to the antenna via low loss waveguide and a transmit monitor coupler.

2.2.2. RECEIVE SUBSYSTEM

2.2.2.1 Earth Station Receive Subsystem

Downlink traffic from the satellite will be received by a highly directional antenna and low noise amplifier. The

low noise amplifier will be mounted directly on the antenna feed behind the antenna in an environmentally controlled enclosure to provide optimum system G/T. The proposed earth station will meet or exceed the G/T of 35.5 dB/K specified in the RFP. A block diagram of the proposed earth station receive subsystem is shown in Figure 2-4. The receive signals from the output of the low noise amplifier will be routed to the down-converters via low loss waveguide and a power divider. Additional output ports will be provided in the power divider for local monitoring and future expansion. The down-converters will translate the RF carriers to 70-MHz IF carriers. IF equalization will be provided to compensate for any phase delay in the TV transmission. A separate demodulator will be provided to demodulate each IF carrier. The baseband output of each 15-kHz channel will be routed through an expander and low pass filter, prior to interfacing with the microwave terminal. The TV output will be processed via a clamper and distribution amplifier which will provide DC restoration and outputs for local monitoring. The TV associated audio output will be passed to the audio distribution amplifier for level setting and monitoring. A patch panel will be provided for the baseband interface with the microwave terminal.

2.2.2.2 Terrestrial Microwave Receive Link

The terrestrial microwave receive link from the interconnect earth station to the FBIS headquarters at Rosslyn will be similar to the transmit link and the description given

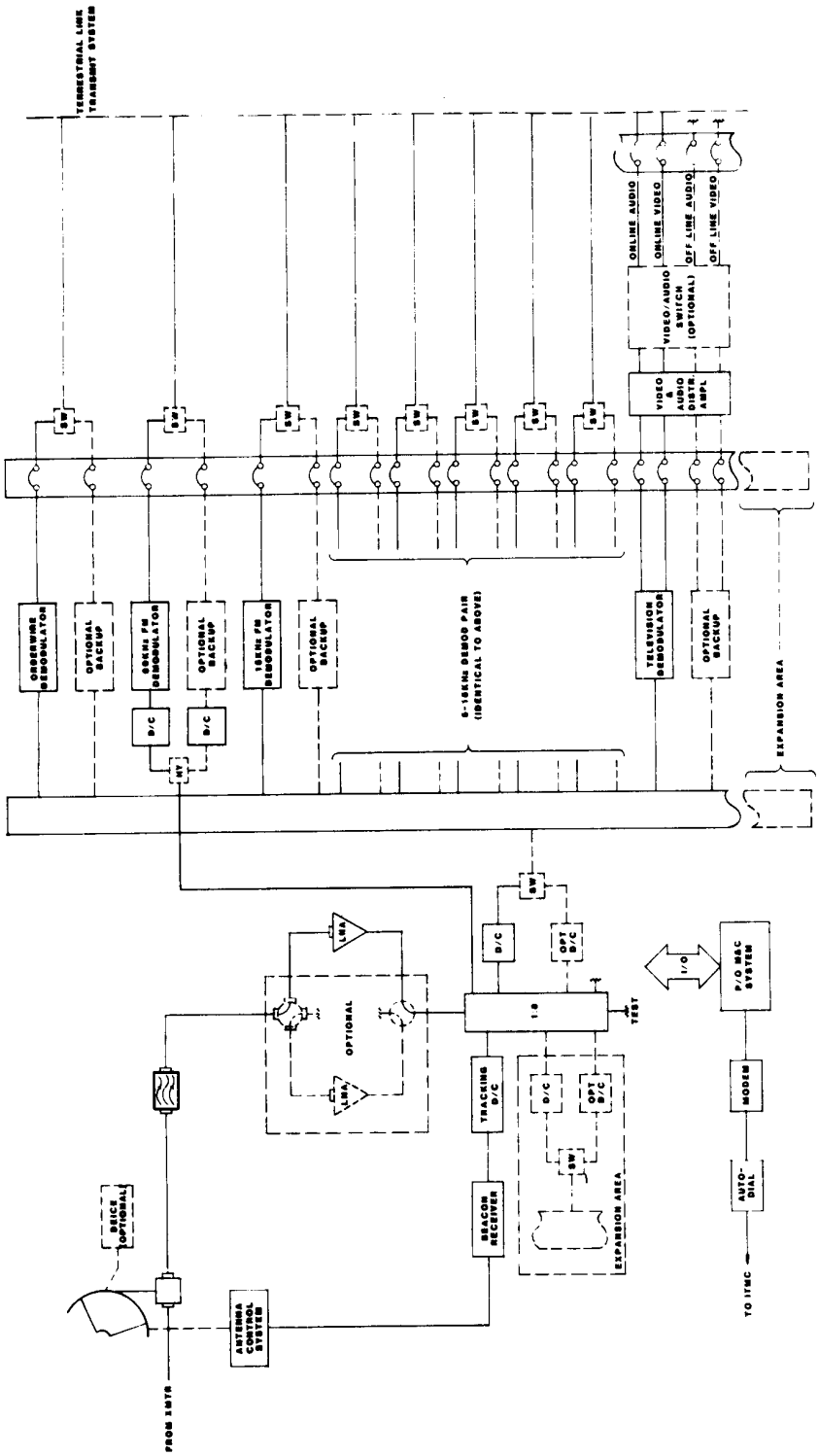


Figure 2-4. FBIS Earth Station Receive System

in Section 2.2.1.1 applies. A block diagram of the microwave receive subsystem at the FBIS headquarters is shown in Figure 2-5.

2.2.3 STANDARD B EARTH STATION MANDATORY CHARACTERISTICS

The proposed earth station is in full compliance with the performance requirements for a Standard B earth station in the INTELSAT system as specified in INTELSAT BG-28-74E (Rev. 1). In this section, the mandatory characteristics, specified in INTELSAT BG-28-74E (Rev. 1), are addressed individually and their compliance is described (see the underlined references, which follow in this section). System analysis, where required, is provided in support of the compliance statement, assuming typical operational parameters in Section 2.3.

2.2.3.1 Gain-to-Noise Temperature Ratio (Reference 4.2)

The gain-to-noise temperature ratio is specified in the frequency band of 3.7 to 4.2 GHz as:

$$G/T = 31.7 + 20 \log_{10} f/4 \text{ dB/K}$$

As demonstrated in Table 2-1, the G/T of the proposed 15-meter antenna combined with an LNA of 35°K noise temperature

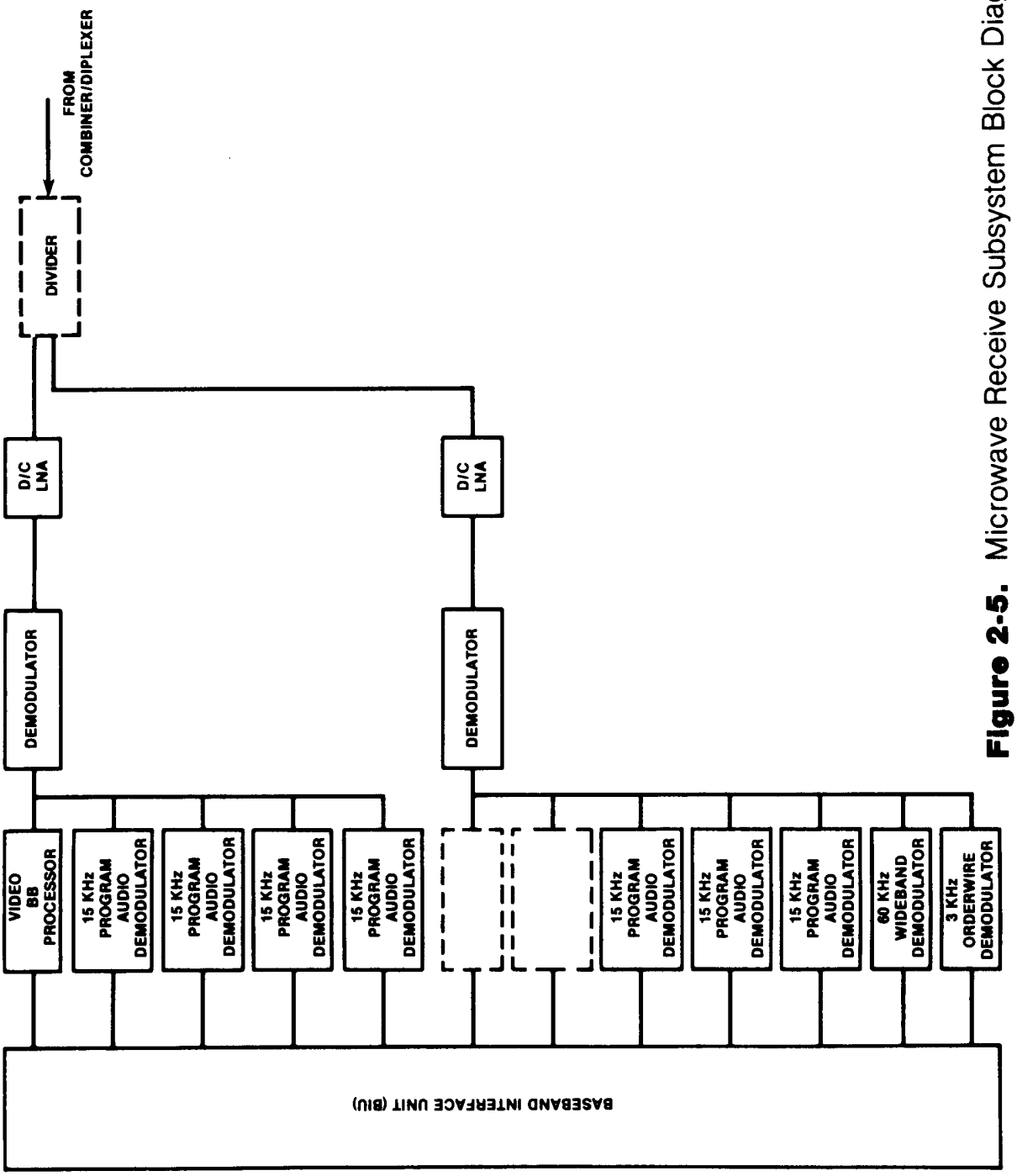


Figure 2-5. Microwave Receive Subsystem Block Diagram

Table 2-1. Receive System Figure of Merit
15-Meter Antenna System

Receive Frequency	4	GHz
Antenna Receive Gain	54.6	dBi
Antenna Noise Temperature*	34	°K
Feeder and Transmit Reject Filter Contribution	12	°K
LNA Noise Temperature	35	°K
System Noise Temperature	82 19.1	°K dB
Figure of Merit, G/T	35.5	dB/K

*Near operating elevation angle of 22 degrees.

is 35.5 dB/K at 4 GHz. The earth station's figure of merit is thus well in excess of the specified minimum of 31.7 dB/K.

2.2.3.2 Transmit Antenna Main Beam Gain (Reference 4.3)

The transmit gain of the proposed 15-meter antenna at 6 GHz is 57.6 dB, well in excess of the required value of 53.2 dB.

2.2.3.3 Antenna Sidelobe Patterns (Reference 4.4)

The sidelobe patterns of the proposed antenna will comply with the FCC two-degree satellite spacing requirements. Because these requirements are more stringent than those of INTELSAT, compliance will automatically assure compliance with INTELSAT's specifications.

	15-Meter Antenna	INTELSAT (dBi) Specification	FCC (dBi) Specification
1st sidelobe	-13 dB	--	--
$1° \leq \theta \leq 7°$	$29-25 \log_{10} \theta$ dBi	$32-25 \log_{10} \theta$ dBi	$29-25 \log_{10} \theta$ dBi
$7° \leq \theta \leq 9.2°$	+8 dBi	$32-25 \log_{10} \theta$ dBi	+8.0 dBi
$9.2° \leq \theta \leq 48°$	$32-25 \log_{10} \theta$ dBi	$32-25 \log_{10} \theta$ dBi	$32-25 \log_{10} \theta$ dBi
$48° \leq \theta \leq 180°$	-10 dBi	-10 dBi	-10 dBi

2.2.3.4 Earth Station Polarization (Reference 4.5)

The earth station will operate using an INTELSAT VA satellite transponder in the global beam. For this operation, the earth station transmit mode will be left-hand circular polarization (LHCP) and the receive mode will be right-hand circular polarization (RHCP) as specified by INTELSAT.

2.2.3.5 Earth Station Axial Ratio (Reference 4.6.2)

The voltage axial ratio of the 15-meter antenna is compared with the specification below:

15m Antenna	INTELSAT Specification for Global Beam	INTELSAT Specification for New Antenna
1.06	1.4	1.06

2.2.3.6 Antenna Beam Steerability (Reference 4.7)

The antenna is equipped with a motorized drive system with both automatic and manual control. The antenna steerability range is ±30 degree for azimuth range and 5 to 90 degree for elevation. The azimuth and elevation rate is about 0.015 degree/second.

2.2.3.7 Tracking Mode (Reference 4.8)

A step-track system with a tracking accuracy of 0.023 degree RMS is used.

2.2.3.8 Feed System Bandwidth (Reference 4.9)

	Proposed Antenna	INTELSAT Specification
Receive Feed System	3.7 to 4.2 GHz	3.7 to 4.2 GHz
Transmit Feed System	5.925 to 6.425 GHz	5.925 to 6.425 GHz

2.2.3.9 Receive System Bandwidth (Reference 4.10)

The operating frequency range of the proposed low noise amplifier and down-converter is 3.7 to 4.2 GHz. The receive system is capable of receiving any carrier within this frequency range.

2.2.3.10 Transmit System Bandwidth (Reference 4.11)

The operating frequency range of the proposed up-converter, the HPA, and the antenna for transmission is 5.925 to 6.425 GHz. The transmit system is capable of transmitting one or more carriers simultaneously anywhere within this frequency band.

2.2.3.11 e.i.r.p (Reference 4.12)

INTELSAT specifies the transmit e.i.r.p. for a 30 MHz TV carrier received by a Standard B earth station (G/T of 31.7 dB/K) via a global beam at 10 degree elevation angle as 85.0 dBW.

SCPC/FM modulation for a 15-kHz wideband channel is not a standard mode of operation for INTELSAT Standard B earth stations and therefore, no e.i.r.p. specifications are provided. The e.i.r.p. levels for these carriers were based on assumptions regarding required signal-to-noise ratios.

The e.i.r.p. analysis presented in Section 2.3 shows that the proposed earth station is capable of providing the required e.i.r.p. for the specified carriers.

2.2.3.12 RF Out-of-Band Emission (Reference 4.13)

Spurious emissions, due to noise sources other than multicarrier intermodulation products, will not exceed 4 dBW in any 6 kHz band within the 5925-6425 MHz frequency range.

The e.i.r.p. of intermodulation products resulting from multicarrier operation will not exceed 24 dBW/4 kHz within the frequency range of 5925-6425 MHz in the global beam coverage at 10 degree elevation angle.

2.2.3.13 Television Carriers (Reference 4.15)

General: The proposed video exciter and receiver have been designed to meet the requirements of INTELSAT BG-28-72.

2.2.3.14 Carrier Frequency Tolerance (Reference 4.15.2)

Modulator Frequency Stability: ±10 kHz
Up-converter Frequency Stability: ±6 kHz

The overall frequency stability of 11.7 kHz is well under the specified value of ±250 kHz.

2.2.3.15 RF Energy Dispersal (Reference 4.15.4)

The proposed video exciter is equipped with an energy dispersal generator module that generates an automatically applied triangular spreading waveform having a frequency of 25/30 Hz synchronized to the frame rate (525/625 video) and locked to the 50/60 Hz line frequency. Stability is ±1 Hz. The energy dispersal (EDF) level is automatically controlled to maintain sufficient FM deviation of the radiated RF energy to reduce the e.i.r.p. power density in a 4 kHz band by 24 dB compared to that of an unmodulated carrier. The EDF will produce 1 MHz peak-to-peak deviation of the television carrier in the presence of the video signal (both picture and

synchronizing signals) and of 2 MHz peak-to-peak deviation in the absence of the video signal.

2.2.3.16 Pre-emphasis and De-emphasis (Reference 4.15.5)

The pre-emphasis characteristics of the proposed video exciter and the de-emphasis characteristics of the video receiver are in accordance with CCIR Recommendation No. 405-1.

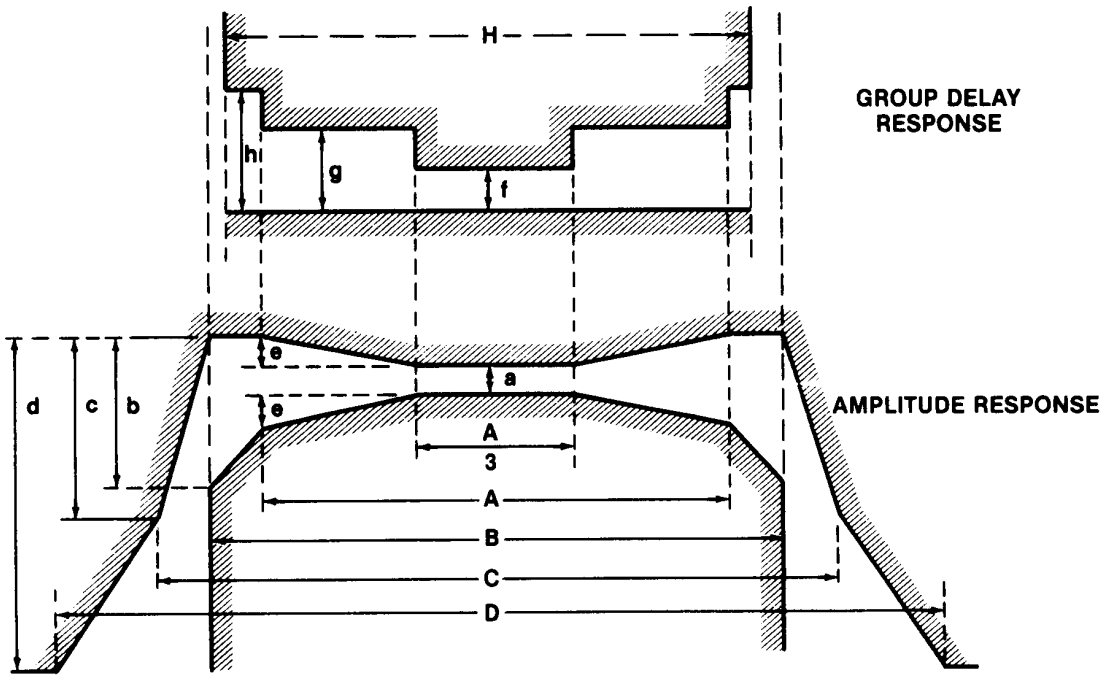
The pre- and de-emphasis for the audio subcarrier are in accordance with CCITT Recommendation No. J. 17.

2.2.3.17 Group Delay Equalization (Reference 4.15.6)

The IF filter/equalizer module in the video exciter will provide amplitude and group delay equalization and will prevent adjacent channel interference. The proposed group delay equalizer is a continuous variable type and will be adjusted to meet the INTELSAT mask (as shown in Figure 2-6). The following response characteristics are given to explain Figure 2-6.

Group Delay Response Characteristics For Full Transponder TV.

A (MHz)	H (MHz)	f (ns)	g (ns)	h (ns)
24.0	30.0	5	5	15



MASKS — INTELSAT BG-28-74E (Rev.1)

Figure 2-6. Transmit Amplitude and Group Delay Response

Amplitude Response Characteristics For Full Transponder TV

A (MHz)	B (MHz)	C (MHz)	D (MHz)	a (dB)	b (dB)	c (dB)	d (dB)	e (dB)
24.0	30.0			0.5	2.5			0.3

2.2.3.18 Transmit IF and RF Equipment Amplitude Characteristics (Reference 4.15.7)

Using the IF filter/equalizer modules the amplitude response of the transmit chain for the TV carrier will be equalized to meet the INTELSAT mask (Figure 2-6).

In addition to equalization, out-of-band filtering is also provided for the TV carrier. The IF filter provides high out-of-band rejection to provide adjacent channel interference and spectrum limiting with a bandwidth ratio (25 dB to 2.5 dB) of 1.3 to 1.

2.3 SYSTEM ANALYSIS

This section provides an analytical basis for the earth station design and illustrates some of the analytical capabilities that COMSAT International will draw upon to provide solutions during the earth station development and implementation phases. The analytical results are preliminary and do not reflect optimized carrier and transmission parameters.

2.3.1 MICROWAVE SYSTEM PERFORMANCE

The microwave path has been engineered to provide a large margin of system gain and wide AGC operational range to provide a high level of reliability and fade margin in the system.

The video and audio subcarriers will meet the full RS-250B performance specifications during conditions when the microwave fade is less than 28 dB. If a fade greater than 28 dB occurs the S/N ratio will decrease to less than 60 dB at a linear rate down to the FM receiver threshold of -79 dBm at which time the S/N would drop to 37 dB before the squelch circuit cuts off the radio link.

2.3.2 EARTH STATION COORDINATES AND LOOK ANGLES

The look angles (azimuth angle and elevation angle) and slant range for an FBIS station located at Quantico and operating with the INTELSAT-VA satellite located at 332.5°E are listed in Table 2-2.

Table 2-2. Earth Station Pointing Angles and Slant Range

Satellite Earth Station Location	INTELSAT VA Quantico Marine Base
Satellite Longitude	27.5 Deg. W
Earth Station Longitude	77.458 (77-27'-30") Deg. W
Earth Station Latitude	38.625 (38-37'-30") Deg. N
Elevation Angle	22.151 Deg. W
Azimuth Angle	117.68 Deg.
Slant Range	39486 km

Typical performance of the system would be as follows:

Amplitude vs Frequency Response

10 kHz to 300 kHz	±.15 dB Maximum
300 kHz to 5 MHz	±.25 dB Maximum
5 MHz to 8 MHz	±.5 dB Maximum
Chrominance/Luminance:	
Gain Inequality (RCL)	±1 IRE unit Maximum
Delay Inequality (RCD)	±20 ns Maximum
Waveform Distortion:	
Field Time (FD)	3 IRE units (Clamped Output)
Line Time (LD)	1 IRE unit
Short Time (SD)	4 IRE units
Differential Gain	2% Maximum
Differential Phase	.2 Degree Maximum
Signal-to-Noise	60 dB Minimum (10 Hz to 10 kHz)
Signal-to-Noise	70 dB Minimum (10 kHz to 5 MHz)

For a microwave link that involved multiple hops as would be the case with the Quantico earth station, the following system specifications would be expected for a worst case system.

Gain Inequality (RCL)	±2 IRE units Maximum
Differential Gain	2.5% Maximum
Differential Phase	.5 Degree Maximum
Signal-to-Noise	58 dB Minimum (10 Hz to 10 kHz)
Signal-to-Noise	67 dB minimum (10 kHz to 5 MHz)

2.3.3 RECEIVE SYSTEM ANALYSIS

2.3.3.1 Receive System Figure of Merit

The figure of merit (gain-to-noise temperature ratio) for the FBIS earth station featuring an 15-meter antenna and 35 K LNA is calculated to be 35.6 dB/K at 4095 MHz, (see Table 2-1).

2.3.3.2 Receive Link Gain, Loss, and Level Analysis

The maximum expected total receive flux density in the ISV global beam is -131.9 dBW/m^2 (-101.9 dBm/m^2). The effective aperture A_{eff}, of the 15-meter antenna at 4095 MHz is:

$$A_{eff} = G \frac{\lambda^2}{4}$$

Where: λ = Wavelength at 4095 MHz, 0.073m
G = Antenna gain at 4095 MHz, 54.8 dB.

$$A_{eff} = 21.1 \text{ dB}$$

The level of the receive signal, R_s at the output of the antenna is:

$$R_s = -101.9 + 21.1 = -80.8 \text{ dBm}$$

2.3.4 TRANSMIT SYSTEM ANALYSIS

2.3.4.1 Carrier Level and e.i.r.p. Calculations

INTELSAT BG-28-74E (Rev. 1) specifies the e.i.r.p. for a TV carrier to an INTELSAT Standard B earth station as 85.0 dBW at a 10-degree elevation angle. The e.i.r.p. levels for the SCPC/FM carriers, however, are not specified in this document. They were calculated based upon assumed values for signal-to-noise ratio, carrier-to-noise ratio and improvements due to emphasis, weighting, and companding as applicable.

2.3.4.2 e.i.r.p. Availability

The e.i.r.p. analysis presented in Table 2-3, demonstrates that the proposed 3 kW klystron HPA and the 15-meter antenna are capable of providing the required maximum e.i.r.p. with the HPA output power backed off for multicarrier operation.

2.3.4.3 e.i.r.p. Stability

The gain stabilities of the principal unit of the transmit system and the net e.i.r.p. stability are listed in Table 2-4.

Table 2-3. FBIS e.i.r.p. Analysis

Transmit Frequency	6320 MHz
Antenna Diameter	15 m
Antenna Gain	57.83 dBi
Maximum HPA Output	34.8 dBW
HPA-Antenna Loss	1 dB
Maximum Available e.i.r.p.	91.63 dBW
Number of Carriers	9

Carrier Configuration

Carrier:	e.i.r.p.:
TV	85 dBW
Orderwire	56.9 dBW
Facsimile (300 kHz)	72.5 dBW
Program (15 kHz)	69.7 dBW (six carriers)
Total e.i.r.p.	85.36 dBW
HPA output backoff	6.27 dB

Note: Carrier e.i.r.p. at 10 degree elevation.

Table 2-4. e.i.r.p. Stability Analysis

Antenna Gain Stability	±.25 dB
HPA Gain Stability	±.25 dB
GCE Gain Stability	±.25 dB
Modem Gain Stability	±.25 dB
e.i.r.p. Stability	±.5 dB

Since the stabilities of individual stages are statistically independent, the e.i.r.p. stability is calculated as the root sum square of individual gain stabilities.

The antenna gain stability is determined using the following parabolic approximation to the antenna gain:

$$\frac{dB_1}{dB_2} = \frac{\theta 1^2}{\theta 2^2}$$

Where: dB_1 = Antenna Gain Stability
$\theta 1$ = Tracking Accuracy
dB_2 = 3 dB
$\theta 2$ = 3 dB Beamwidth

2.3.4.4 RF Out-of-Band Emission

The RF out-of-band emission results from two principal sources:

1. The spurious emission products generated by spurious tones, bands of noise and other undesirable signals, but excluding multicarrier intermodulation products,
2. The intermodulation products generated by multicarrier interaction in the nonlinear elements of the transmit system.

INTELSAT BG-28-74E (Rev. 1) stipulates a limit of 4 dBW/4 kHz within the 5925 to 6425 MHz frequency range for the spurious emission products and of 24 dBW/4 kHz in the 5925 to 6425 MHz frequency range at a 10-degree elevation angle for the intermodulation products for operation in the global beam.

a. Spurious Emission Products

The spurious emission products are mostly generated by the up-converter and HPA. The spurious outputs of the up-converter are reduced by the rejection characteristics of the klystron HPA and by the transmission losses. The spurious outputs of the HPA are also reduced by the rejection characteristics of the klystron tube itself and by the transmission losses.

The noise power density at the output of the HPA at a power level of 3 kW is -64 dBm/kHz. This results in an e.i.r.p. of -31.4 dBW/4 kHz.

The spurious outputs (discrete frequency components) of the HPA are -70 dBW/4 kHz over 5.9 to 6.4 GHz. These translate to an e.i.r.p. of -13.4 dBW/4 kHz.

The spurious output from the up-converter results primarily from local oscillator leakage and is at or below -65 dBm/4 kHz, and is outside the 5925 to 6425 MHz band. The e.i.r.p. corresponding to this output is expected to be below the INTELSAT specified limit due to the rejection characteristics of the HPA.

b. Out-of-Band Emission Due to Intermodulation

Typical transfer characteristics of a klystron tube are shown in Figure 2-7 and the two carrier intermodulation characteristics are shown in Figure 2-8.

At COMSAT International, computer-aided simulation and analysis of intermodulation products are performed using COMSAT-developed carrier intermodulation analyzer (CIA4) program. A typical output of this program showing the intermodulation power spectral density distribtuion at various operating points of the HPA is shown in Figure 2-9.

Using the CIA4 program, the carrier frequency plan and the HPA operating point will be optimized to ensure that intermodulation levels are under the 24 dBW/4 kHz limit specified by INTELSAT.

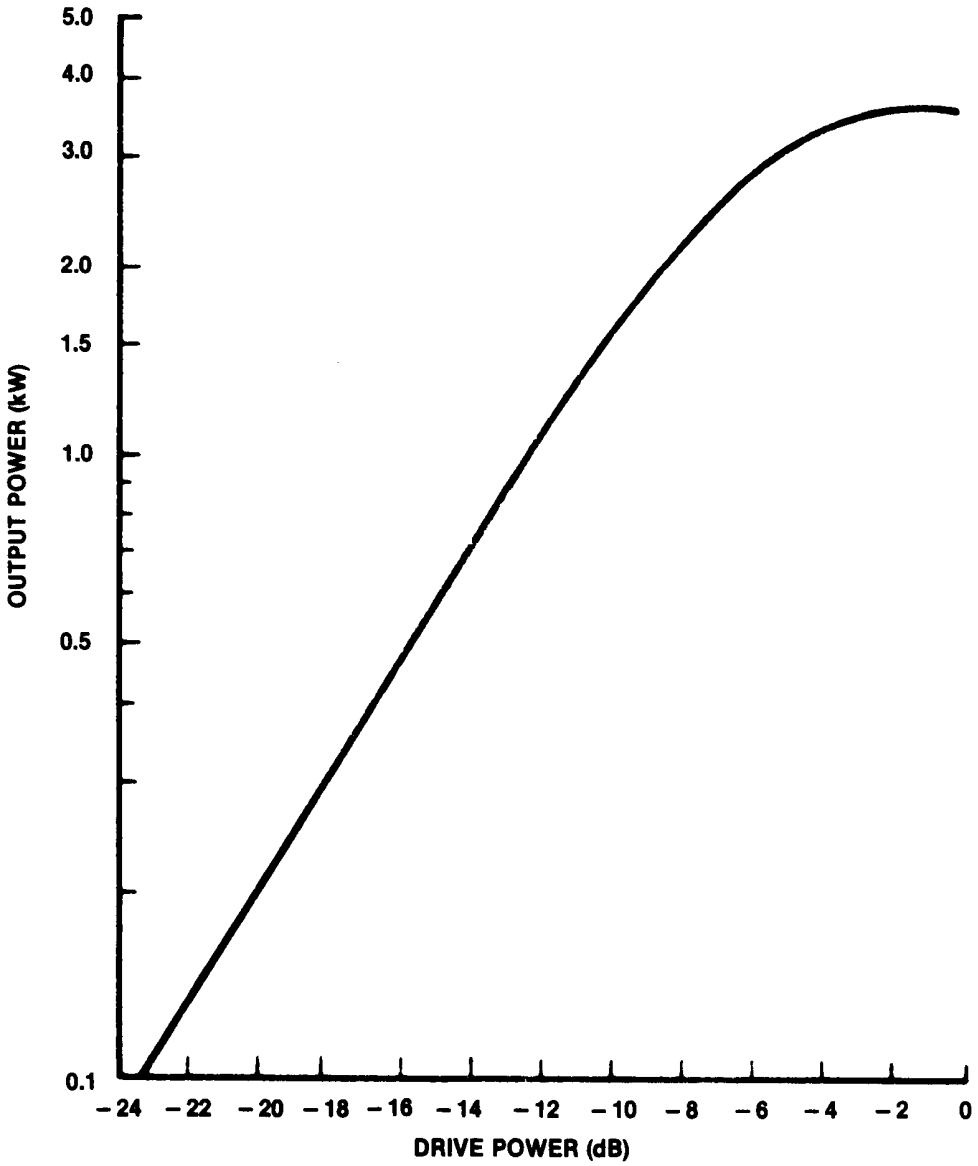
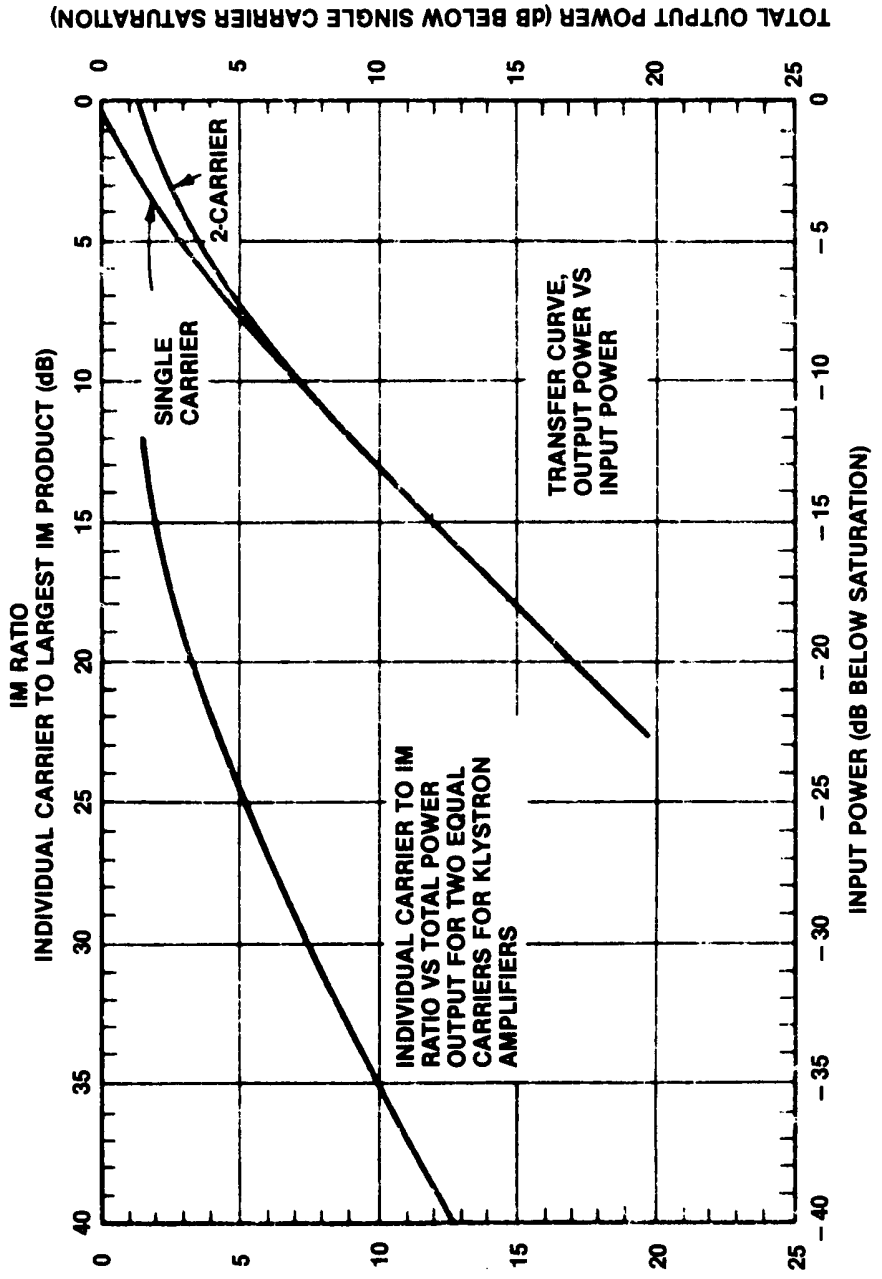


Figure 2-7. Typical Klystron Transfer Characteristics



2-8. Two Carrier Intermodulation Characteristics For Klystron Amplifier

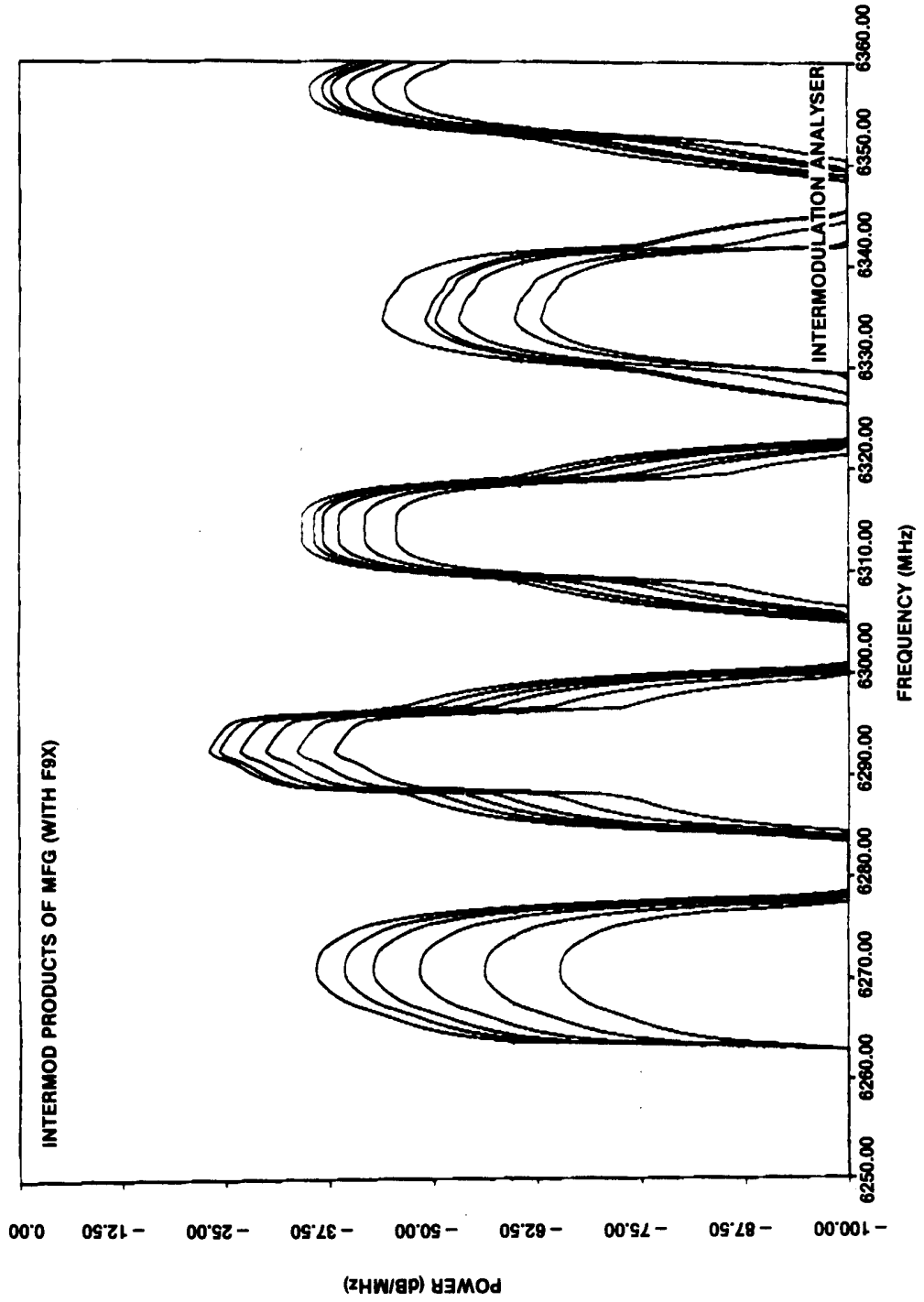


Figure 2-9. Intermodulation Power Spectral Density

2.3.5 SATELLITE LINK ANALYSIS

For the satellite link analysis, a system model consisting of two FBIS earth stations and a global beam transponder in the INTELSAT VA satellite located at 332.5°E longitude is used.

The characteristics of a typical global beam transponder (#10), summarized in Table 2-5, are used in the link analysis.

For the purpose of illustration, a TV carrier is considered. Typical operational parameters are assumed. The satellite TWTA is assumed to be fully loaded with specified service carriers.

Table 2-6 illustrates the satellite link performance for the case of the FBIS Quantico earth station transmitting to a foreign earth station in the INTERNET network.

Table 2-7 illustrates the satellite link performance for the case of a foreign INTERNET earth station transmitting to the FBIS, Quantico earth station.

The foreign earth station is assumed to possess a figure-of-merit (G/T) of 34 dB/K with a 13-meter antenna.

2.3.5.1 Satellite Link and Carrier Performance Summary

Satellite link and carrier performance levels, expected on the basis of preliminary analysis, are listed in Table 2-8. These are illustrative and may be revised following optimization of the transmission plan and earth station design.

Table 2-5. Satellite Transponder Characteristics

Satellite:	INTELSAT VA
Location:	332.5°E Longitude
Transponder:	#10
Beam:	Global Up/Global Down
Bandwidth:	36 MHz
Receive Center Frequency:	6320 MHz
Transmit Center Frequency:	4095 MHz
Saturation Flux Density:	
High Gain:	-77.6 dBw/m^2
Low Gain:	-70.1 dBw/m^2
Maximum e.i.r.p.	23.5 dBw
Satellite G/T	-16.0 dB/K

Table 2-6. Satellite Link Analysis

Carrier:	TV
Transmitting Earth Station:	FBIS, Quantico, Virginia
Receiving Earth Station:	Foreign Station (INTERNET)

a. Uplink Analysis

Transmit Frequency:	6320 MHz
Antenna Diameter:	15 M
Antenna Gain:	58.1 dBi
HPA-Saturated Power	34.8 dBw
Output Backoff and Feeder Loss	10.9 dB
e.i.r.p.	82.0 dBw
Spreading Loss	162.9 dB
Free Space Loss	200.2 dB
Flux Density at Satellite	-80.9 dBw/m^2
Saturation Flux Density	-77.6 dBw/m^2
Satellite Input Backoff	3.3 dB
Satellite G/T	-16.0 dB/K
Uplink C/N_O	94.3 dB.Hz

Table 2-6. Satellite Link Analysis (Cont')

Carrier:	TV
Transmitting Earth Station:	FBIS, Quantico, Virginia
Receiving Earth Station:	Foreign Station (INTERNET)

b. Downlink Analysis

Receive Frequency:	4095 MHz
Satellite e.i.r.p. (at Saturation):	23.5 dBw
Output Backoff:	2.0 dB
Spreading Loss	162.9 dB
Free Space Loss	196.6 dB
Earth Station G/T	34.0 dB/K
Downlink C/N_O	87.5 dB.Hz
(C/N_O) Satellite Intermodulation	95.0 dB.Hz
(C/N_O) Frequency Reuse	98.9 dB.Hz
(C/N_O) Interference	96.5 dB.Hz
(C/N_O) Total	85.5 dB.Hz

Table 2-7. Satellite Link Analysis

Carrier:	TV
Transmitting Earth Station:	Foreign Station (INTERNET)
Receiving Earth Station:	FBIS, Quantico, Virginia

a. Uplink Analysis

Transmit Frequency:	6320	MHz
Antenna Diameter:	13	M
Antenna Gain:	56.7	dBi
HPA Saturated Power	34.8	dBw
Output Backoff and Feeder Loss	9.5	dB
e.i.r.p.	82.0	dBw
Spreading Loss	162.9	dB
Free Space Loss	200.4	dB
Flux Density at Satellite	-80.9	dBw/m^2
Saturation Flux Density	-77.6	dBw/m^2
Satellite Input Backoff	3.3	dB
Satellite G/T	-16.0	dB/K
Uplink C/N_o	94.3	dB.Hz

Table 2-7. Satellite Link Analysis (Cont')

Carrier:	TV
Transmitting Earth Station:	Foreign Station (INTERNET)
Receiving Earth Station:	FBIS, Quantico, Virginia

b. Downlink Analysis

Receive Frequency:	4095 MHz
Satellite e.i.r.p. (at Saturation):	23.5 dBw
Output Backoff:	2.0 dB
Spreading Loss	162.9 dB
Free Space Loss	196.6 dB
Receive Antenna Diameter	15 M
Antenna Gain	54.8 dBi
Antenna Temperature (at 20°Elev.)	34°K
LNA Temperature	35°K
Noise due to Misc. Loss	12°K
System Temperature	81°K
Earth Station G/T	-35.7 dB/K
Downlink C/N_O	89.2 dB.Hz
(C/N_O) Satellite Intermodulation	95.0 dB.Hz
(C/N_O) Frequency Reuse	98.9 dB.Hz
(C/N_O) Interference	96.5 dB.Hz
(C/N_O) Total	86.5 dB.Hz

Table 2-8. Satellite Link and Carrier Performance Summary

Receive Earth Station Antenna		15m
Television Carrier		
C/N_O	dB.Hz	86.5 dB.Hz
S/N		
NTSC	525/60	46.7*
PAL	625/50	47.0*
SECAM	625/50	45.1*
Wideband SCPC		
C/N_O	dB.Hz	75.4
S/N	dB	53.4
15 kHz SCPC		
C/N_O	dB.Hz	68.0
S/N	dB	64.0
Orderwire SCPC		
C/N_O	dB.Hz	63.0
S/N	dB	64.2

*Slight overdeviation could be used to improve the video S/N performance by about three dB without major degradation in other video characteristics.

2.3.5.2 Terrestrial Interference

The preliminary RFI survey provided by FBIS indicates the existence at Quantico of interfering signals within the receive frequency band occupied by INTELSAT global beam transponders. None were found in the transmit bands. The global transponder bands and the potentially interfering signals are shown in Table 2-9. It can be seen from the table that Transponder 10 is totally clear of terrestrial interference and, therefore, so long as FBIS traffic is confined to that transponder no terrestrial interference problem exists. Other characteristcs of the Quantico RFI environment given in the report are as follows:

a. The maximum interfering signal level as measured in a 300 kHz bandwidth was -122 dBmi.
b. The interfering signals were concentrated in the segment defined by 330 degrees magnetic north to 360 degrees magnetic north.

To assess the potential signal impairment that the identified interferers may cause we proceed as follows.

We recognize from item b. above that the interfering signals can enter the Quantico antenna only through sidelobes at angles greater than 48 degrees. This is because the antenna azimuth angle will range from 111 degrees to 144 degrees as it sweeps along the geostationary arc from 18.5 degrees to 53 degrees. The gain of the antenna beyond 48 degrees from the

Table 2-9. Global Transponders and Interfering Signals

Global Transponder#	Global Transponder Frequency Range (MHz)	Interfering Carrier Frequency (MHz)
(7-8)	3959	3960, 3980, 4000
	4031	
9	4037	4040
	4073	
10	4077	No Interfering Carriers Reported
	4113	
11	4117	4120
	4153	
12	4157	4160
	4198	

main beam axis will not exceed the mandatory FCC and INTELSAT sidelobe envelope -10 dBi and therefore, the signal levels given in the report are adjusted by that amount. The maximum interfering signal level in a 4 kHz bandwidth assuming that the reported signal power is uniformly spread over 300 kHz bandwidth is calculated as follows:

- Maximum Interfering Signal Level:	-122.0 dBmi
- Sidelobe Coupling	-10.0 dBi
- 300 kHz to 4 kHz Conversion:	-18.8 dB
- Maximum interfering signal density in a 4 kHz bandwidth:	-150.8 dBm/4 kHz

In order to assess the worst-case interference problem the case of the smallest desired carrier, the voice orderwire is analyzed.

The occupied bandwidth of the orderwire is assumed to be 25 kHz and the carrier level is assumed to be 32 dB below saturation.

- Maximum Satellite e.i.r.p.:	23.5 dBW
- Carrier Level Relative to Saturation: (Typical)	-32.0 dB
- Propagation Loss	197.0 dB
- Antenna Gain	54.6 dB
- 4 kHz-to-25 MHz Conversion:	-8.0 dB
- Signal Level in 4 kHz:	-158.9 dBW
	-128.9 dBm/4 kHz

The carrier-to-interference ratio is thus found to be approximately 22 dB. This value is based on assumptions cited before that are necessary in the absence of specific details concerning both desired and interfering carrier characteristics.

The actual and realizable C/I will depend upon the exact antenna location and signal characteristics. The terrestrial interference can be alleviated through judicious choice of carrier frequencies and transmission parameters to avoid spectral overlap or by natural or artificial interference shielding at the earth station. Specific details of the latter alternative, will be a function of the exact site location (which is influenced by a variety of factors), and their establishment must await the results of detailed RFI clearance and site surveys.

2.3.6 RELIABILITY AND AVAILABILITY ANALYSIS

2.3.6.1 General

Compliance with the earth segment availability requirement of 99 percent has been verified by the reliability and availability analyses performed at the equipment, subsystem and system levels. The preliminary results of these analyses, summarized in Table 2-10 indicate an overall earth segment availability of 99.20 percent. The system analyzed is the one offered in the basic proposal with the following key features:

Table 2-10. FBIS Earth Segment System Availability

Equipment		Subsystem		System
Earth Station Receiver	99.88%	Earth Station	99.80%	99.20%
Earth Station Transmitter	99.92%			
6 GHz Link Transmitter	99.95%	Terrestrial Microwave Link	99.41%	
6 GHz Link Receiver	99.89%			
Repeater 1	99.88%			
Repeater 2	99.88%			
23 GHz Link Transmitter	99.95%			
23 GHz Link Receiver	99.89%			
Link AC Power	99.99%			
Dist. Amp.	99.96%			
Autodial Line	99.99%	Autodial Line	99.99%	

a. Single-thread IF/RF subsystems at the earth station.
b. Redundancy only for the modulators at the earth station.
c. Single-thread subsystems in the terrestrial microwave link.
d. No antenna deicing.
e. No uninterruptible power supply (UPS).
f. No back-up generator power.

The analyses utilize the mean-time-between-failures (MTBF) and mean-time-to-restore (MTTR) data currently available. The MTBF data are based on field data from component suppliers, on estimates derived from COMSAT/INTELSAT experience, or on estimates calculated by using the methodology and failure rate tables of MIL-Handbook-217, Section 5.2

Based on past experience, the MTTR was estimated at 4 hours for most equipment. It should be noted that this estimate assumes on-site availability of critical spares.

The following key formulas were used:

Configuration	Availability
One Unit	$A_1 = \frac{MTBF}{MTBF + MTTR}$
N Series Units	$A_1' A_2' A_3' \ldots\ldots A_N$
One-For-One Redundancy	$A_1 (2 - A_1)$

Table 2-11 presents the availability model for the complete system. In this model, major elements of the

Table 2-11. Availability Analysis of Satellite Communications Systems

ITEM	MTBF	MTTR	UNIT AVAIL	FUNCTION AVAIL
E/S RCVR	3330	4	.9988	.9988
E/S XMIT	4820	4	.99917	.99917
W/G RUNS	500000	4	.99999	.99999
6 GHZ XMTR	7690	4	.99948	.99948
6 GHZ RCVR	3700	4	.99892	.99892
REPEATER 1	3250	4	.99877	.99877
REPEATER 2	3250	4	.99877	.99877
23 GHz XMTR	7690	4	.99948	.99948
23 GHz RCVR	3700	4	.99892	.99892
AUTODIAL	20000	2	.9999	.9999
DIST. AMP.	100000	4	.99996	.99996
LINK AC POWER	10000	1	.9999	.9999

TOTAL AVAILABILITY = .9920

communications system are shown along with the data on MTBF, MTTR, unit availability, and functional availability.

A considerably higher level of availability is achievable by means of fully redundant system which is offered as an option. The major earth stations operated by COMSAT International are fully redundant with a resulting availability of 99.99 percent. With redundancy in both microwave link and earth station equipment, an availability of 99.98 percent is expected.

2.3.6.2 Snow and Ice Impairments

The foregoing analyses have not included impairments due to snow and ice accumulation on the antenna. Wet snow and ice on the main and subreflectors of an antenna can significantly degrade performance. The need for an antenna deicing system depends on the climatological and meteorological statistics for the local region. The meteorological conditions at Quantico seem to indicate that a deicing system is not required to ensure the 99 percent availability level for the entire system with the 99.2 percent availability for the equipment.

2.3.6.3 On-Site Storage of Critical Spares

The MTTR is a critical determinant of the overall system availability. The assumed value of 4 hours for the MTTR

assures better than 99 percent availability. However, this requires a high level of spare parts availability with very little time allocated for transportation of parts and for technician travel. As such, on-site storage of critical parts is essential to attain the required availability.

2.4 EQUIPMENT LIST

2.4.1 BASIC PROPOSAL (Location at Quantico)

2.4.1.1 Earth Station

		Quantity
a.	15-meter, C-band antenna including tracking system, antenna foundation with grounding and anchor bolts	1
b.	35 degree low noise amplifier with power supply.	1
c.	3-kW klystron amplifier with power supply and harmonic filter	1
d.	Up-converter, dual conversion	1
e.	Down-converter, dual conversion	1
f.	Modulator, 15-kHz program channel	7
g.	Modulator, 8-kHz program channel	2
h.	Modulator, 60 kHz with 300 kHz RMS deviation	2
i.	Demodulator, 15-kHz program channel	6

		Quantity
j.	Demodulator, 8-kHz program channel	1
k.	Demodulator, 60-kHz FM SCPC	1
l.	Modulator, television equipped for NTSC, PAL and SECAM	2
m.	Demodulator, television equipped for NTSC, PAL and SECAM	1
n.	Up-converter C-band, synthesized with 125-kHz steps	1
o.	Down-converter, C-band, synthesized with 125-kHz steps	1
p.	6-foot equipment enclosure rack	5
q.	70 MHz coaxial divider (1:8)	1
r.	4-GHz coaxial divider (1:8)	1
s.	6-GHz coaxial divider (1:4)	1
t.	70-MHz coaxial splitter	4
u.	Transmit monitor test coupler, waveguide	1
v.	Group delay equalizer	2
w.	IFL interconnecting waveguide	100 ft.
x.	Video distribution amplifier with equalizer	1 set
y.	Audio distribution amplifier	1 set
z.	Miscellaneous hardware, brackets, adapters, cables, connectors, fittings and interconnecting waveguide	1 Lot

		Quantity
aa.	Test equipment: spectrum analyzer, signal generator, power meter, frequency counter, waveform monitor, voltmeters, vectorscope, pattern generator with plug-ins, video monitor and sound monitor for NTSC, PAL, SECAM	1 Lot
bb.	Communications Equipment Building with heating ventilation, air conditioning, fire protection, security etc. (As described in Section 4-2.)	1
cc.	Miscellaneous O&M equipment	1 Lot

2.4.1.2 Terrestrial Microwave Link Equipment

The following equipment will be provided at the FBIS terminal location in Rosslyn, Virginia.

Microwave Transceiver Unit, 2 channel	1 ea
Program Channel Modulator	2 ea
Program Channel Demodulator	2 ea
Low Pass Filter Unit VLP 6.5 MHz	4 ea
Service Channel Converter, 130 kHz	1 ea
23 GHz antenna	1 ea
Andrews 4' & 6' Pipe mount	1 ea
WR-42 Waveguide Sections	-
Andrew Dehydrator Unit	1 ea
Andrew Press Unit	1 ea
6' Equipment Enclosure Rack	2 ea

The following equipment will be provided at the repeater sites.

Microwave Transceiver Unit, 2 Channel	4 ea
Service Channel Converter, 130 kHz	1 ea
18 GHz antenna	1 ea
23 GHz antenna	1 ea
WR-42 Waveguide Sections	-
Andrew Dehydrator Unit	2 ea
Andrew Pressure Unit	2 ea

The following equipment will be provided at the earth station site.

Microwave Transceiver Unit, 2 Channel	1 ea
Program Channel Modulator	2 ea
Program Channel Demodulator	2 ea
Low Pass Filter Unit VLP 6.5 MHz	4 ea
Service Channel Converter, 130 MHz	1 ea
6 GHz antenna	1 ea
Andrews 4' & 6' Pipe mount	1 ea
WR-159 Waveguide Sections	-
Andrew Dehydrator Unit	1 ea
Andrew Pressure Unit	1 ea
Tower 70 ft. free standing	1 ea
6' Equipment Enclosure Rack	2 ea

2.5 SITE PLAN

The station layout is shown in Figure 4-1. Some adjustments to this layout may be required once the results of the field survey and soil tests are known. The layout is further dependent on the results of RF interference tests which could have a more profound effect and which could require adjustments which would lie outside the scope of this proposal. The station will be designed to provide continuous geostationary arc coverage between the limits of 18.5 degrees west longitude and 53 degrees west longitude. It will include an improved area of approximately 15,600 square feet within the existing Independence Hill site. In addition, an area of approximately one and three-quarters acres of standing trees to the south and east of the antenna will be cleared to avoid RF path interference.

The developed site will include a 40 foot by 52 foot building with connections to existing water, sewage and power utilities, an access road, parking facilities, a 15-meter antenna, a microwave tower and a perimeter fence.

2.6 FUTURE EXPANSION

The INTERNET earth terminal is configured and will be built to carry the signals specified in the RFP. COMSAT International recognizes, however, that FBIS expects to expand the services in the future up to a quantity of two television channels, two 60-kHz wideband channels, and 20 voice grade

15-kHz channels. This expansion will require the installation of additional equipment. Nevertheless, a number of features are included in the presently proposed design and implementation of the INTERNET earth terminal to facilitate future expanded service. The specific measures taken and features provided are given in Section 3.11.

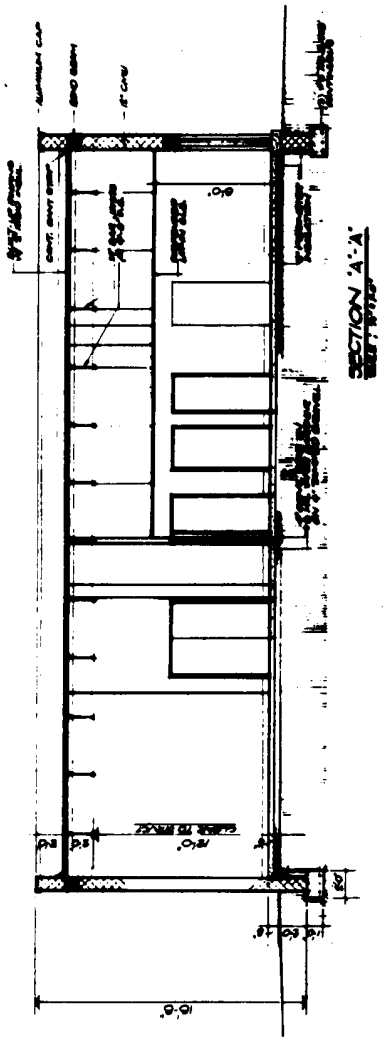
COMSAT INTERNATIONAL COMMUNICATIONS INC.

ITEM NO.	EQUIPMENT	NOTE
1	N/A	FUTURE
2	N/A	FUTURE
3	N/A	
4	N/A	
5	UPTON CONV.	FUTURE
6	UPTON CONV.	FUTURE
7	NEC	
8	NEC	FUTURE
9	DEMOD	
10	DEMOD	
11	M & C / ANT	
12	MUX / BB UNT	
13	TER M/W	
14	TER M/W TWT	
15	UTIL POWER PNL	
16	TECH POWER PNL	OPTION
17	AUTO TR SW	OPTION
18	UPS	OPTION
19	SERV. ENTR.	
20	40 GAL. HOT WATER HEATER	DEMONT
	BATTERY RK	
21	SWITCH	OPTION
	SERVICE PNL	OPTION

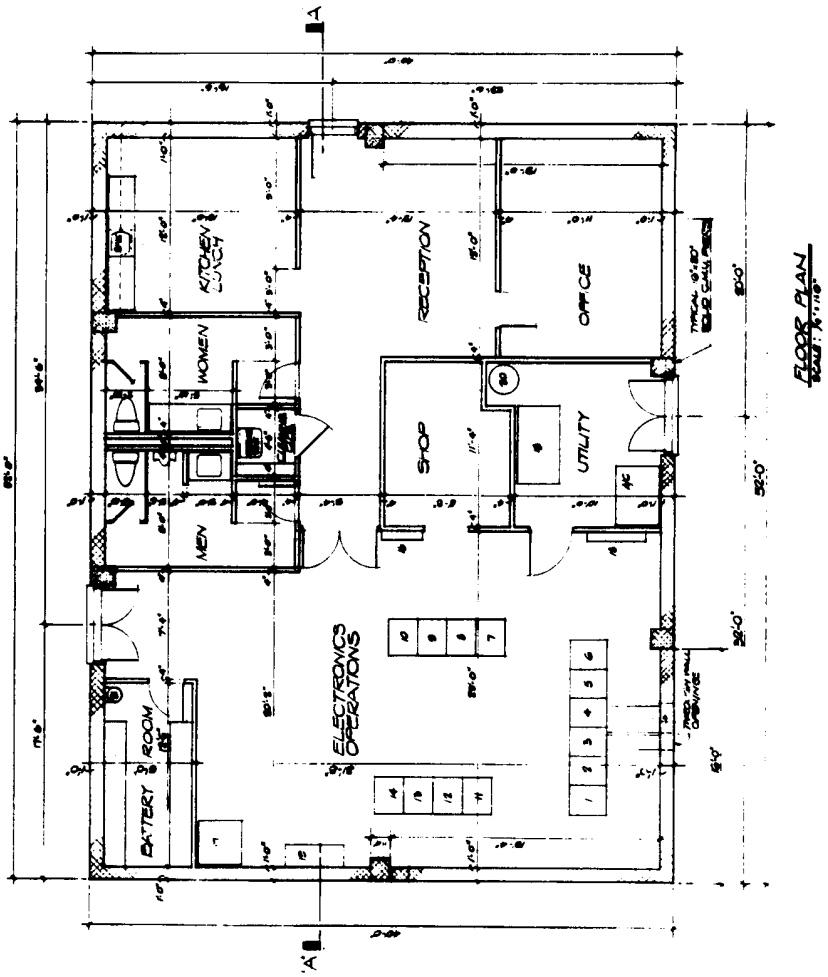
FLOOR PLAN AND SECTION

COMSAT
F.B.I.S. FACILITY
QUANTICO MARINE BASE
VIRGINIA

MADIS VALGE ASSOCIATES
ARCHITECT AIA
850 SLIGO AVENUE SUITE 500
SILVER SPRING MARYLAND 20910



SECTION 'A'-'A'



FLOOR PLAN

COMSAT CONFIDENTIAL

3. EQUIPMENT DESCRIPTION

3.1 GENERAL

This section of the proposal provides detailed descriptions of the proposed equipment and subsystems to be integrated into the FBIS Standard B earth station. All equipment is compliant on a system basis with the performance specifications of INTELSAT BG-28-74E (Rev.1) for Standard B applications.

3.2 ANTENNA SUBSYSTEM

3.2.1 INTRODUCTION

The proposed baseline antenna is a 15-meter elevation over azimuth axis structure with "shaped" cassegrain reflector optics. The minimum G/T with 35°K LNA subsystem is 35.5 dB/K at any elevation angle greater than 15 degrees.

The 15-meter antenna consists of a galvanized steel mount structure, a reflector hub and back structure assembly, precision reflector panels, a subreflector support, low axial ratio feed and subreflector, axis motor drives and mechanical activators, a step-track antenna controller, angle detectors, beacon receiver, beacon down-converter, and a lightning ground. Aircraft warning lights are not included.

The antenna will be mounted on a reinforced concrete foundation pad and will be designed for unattended operation. It will include provisions for manual operation and remote alarms for low signal strength and control system malfunction. Access provisions to the low noise amplifier system located in the hub of the main reflector are included.

3.2.2 STRUCTURAL DESIGN

The principal operational requirements of the antenna are to maintain a well-focused RF beam under all environmental conditions and to maintain the beam pointed accurately at a moving satellite under the same conditions. These objectives call for rigidity in the structural design of the foundations, pedestal structure and mechanical drives, and for closed loop tracking of the satellite. Rigidity of the structures and drives is achieved by careful analysis and design of all components based on wind loadings derived from wind tunnel testing of antenna models. Many elements require special design in order that they possess adequate rigidity to control deflections under the prescribed operational loads. The antenna will be designed to survive winds of 120 mph. The normal maximum operational windspeed for the antenna is 60 mph.

Of course, the antenna reflecting surface must accurately conform to the desired "shaped" profile before any external loads are applied. The reflector static alignment will, therefore, be assured by optical measurement after field erection. This will be followed by antenna sidelobe and gain

measurements which both depend heavily on the precision of the antenna surfaces.

The reflector hub, while providing a rigid attachment for the radial ribs of the back structure, serves as the enclosure for the low noise receiver assembly. Environmental control for this area will be provided as required to assure reliable and stable operation. Access, utility outlets and maintenance lighting will also be provided.

The antenna will be installed on a reinforced concrete pad designed to meet standard 2000 PSF soil bearing pressure. The foundation/soil interface will be undisturbed to enhance its rigidity and stability.

3.2.3 TRACKING SYSTEM

Satellite tracking will be accomplished using a step-track system. In this system, the received beacon strength from the satellite is measured, the antenna moved on one axis through a small angle and the beacon strength remeasured. If the signal strength is improved the next step is taken in the same direction, otherwise the direction is reversed. By taking signal strength measurements before and after every step on each axis, the RF beam is accurately and reliably pointed at slow moving, (0.03 degree/hour) quasi-geostationery satellites. Tracking will be intermittent to minimize wear and tear on the drive system mechanical components.

The tracking system will include a beacon down-converter and receiver having two switch selectable beacon frequencies. Two additional alternate frequencies will be available if required with a minimal amount of effort for switchover to the second pair of beacons. Fault monitoring will be provided with remote alarm interface. Angle readouts and system status will be displayed on the step-track controller front panel. The tracking system is designed to maintain a long-term signal strength stability of $\pm$1/4 dB in winds gusting up to 20 mph to meet INTELSAT requirements.

The antenna is moved by an AC motor driving a mechanical jack drive on each axis. The overall antenna travel range will be +5 to +90 degrees in elevation and 90 to 180 degrees or greater in azimuth. Azimuth travel is divided into two overlapping sectors. Under manual control, the antenna may be driven to any elevation angle or any azimuth angle within a sector at a rate of approximately 0.015 degrees per second.

3.2.4 ANTENNA SPECIFICATION

15-METER ANTENNA SPECIFICATION

Location	Quantico, Virginia
Application	INTELSAT Std. B
Life	10 Years
Size (Meters)	15

15-METER ANTENNA SPECIFICATION (Cont')

Tx Gain (dB)	57.6 + 20 log (f/6.0)		
Rx Gain (dB)	54.6 + 20 log (f/4.0)		
Noise Temperature at 10° Elevation	42K		
Axial Ratio	1.06		
Isolation Between Any			
Tx-Tx, Rx-Rx	18 dB		
Tx-Rx	30 dB		
Tx Sidelobes (Max Within 1° of geostationary arc)	29-25 log	dBi 1°	7°
	+8	dBi 7°	9.2°
	32-25 log	dBi 9.2°	48°
	-10	dBi 48°	180°
Rx Sidelobes, and Tx sidelobes beyond 1° of geostationary arc	32-25 log	dBi 1°	48°
	-10	dBi 48°	180°
First sidelobes (max)	13 dB below main beam peak		
Tx band frequencies	3.7 to 4.2 GHz		
Rx band frequencies	5.925 to 6.425 GHz		
Tx and Rx port Input VSWR	1.25:1		
Gain Stability 0 to 20 mph	± 0.25 dB		
Power handling capacity	10 kW total (0 to 5 kW into a single port)		

15-METER ANTENNA SPECIFICATION (Cont')

Tx Gain (dB)	57.6 + 20 log (f/6.0)
Rx Gain (dB)	54.6 + 20 log (f/4.0)
Noise Temperature at 10° Elevation	42K
Axial Ratio	1.06
Isolation Between Any	
Tx-Tx, Rx-Rx	18 dB
Tx-Rx	30 dB
Tx Sidelobes (Max Within 1° of geostationary arc)	29-25 log θ dBi 1° $\leq \theta \leq$ 7° +8 dBi 7° $\leq \theta \leq$ 9.2° 32-25 log θ dBi 9.2° $\leq \theta \leq$ 48° -10 dBi 48° $\leq \theta \leq$ 180°
Rx Sidelobes, and Tx sidelobes beyond 1° of geostationary arc	32-25 log θ dBi 1° $\leq \theta \leq$ 48° -10 dBi 48° $\leq \theta \leq$ 180°
First sidelobes (max)	13 dB below main beam peak
Tx band frequencies	3.7 to 4.2 GHz
Rx band frequencies	5.925 to 6.425 GHz
Tx and Rx port Input VSWR	1.25:1
Gain Stability 0 to 20 mph	$\pm$ 0.25 dB
Power handling capacity	10 kW total (0 to 5 kW into a single port)

Surface Error Static	0.040 inch rms
30 mph gusting to 45	0.045 inch rms
Tracking Error 30 mph gusting to 45	0.1 beamwidth rms
Pointing Error 30 mph gusting to 45	0.15 beamwidth rms
Operational Windspeeds	0 to 60 mph
Drive to Stow (if required)	Up to 80 mph
Survival	120 mph
Travel Range	+5 to 90° Elevation ±45° in Azimuth
Beacon Frequencies	2-switch selectable (plus 2 alternates taking 1 hour to implement)
Deicing System - Automatic	60 w/sq. ft., half reflector (optional)

Other Requirements:

Signal Outputs for Remote Monitoring
  Signal Strength
  Fault Status Drives and Deice
Ground System
Foundation Design and Installation
  (2000 psf - 30" frost penetration)
Packing and Shipping
Installation and Alignment

Field Testing Per List Below
O&M Manuals and Drawings
Training
Spares

Field Testing Schedule:

Surface Accuracy
Gain, Tx and Rx
G/T
Sidelobes Tx and Rx
VSWR Tx and Rx
Axial Ratio
Port-to-Port Isolation
Antenna Controls and Operation
Tracking
Deice Controls and operation

3.3 LNA SUBSYSTEM

3.3.1 LOW NOISE AMPLIFIER

One LNA subsystem is supplied. The LNA subsystem, including the transmit reject filter, will be mounted on a plate. The plate assembly is mounted in the antenna hub as close to the feed as possible. The switch plate and LNAs will be mounted so as to provide easy access for maintenance purposes.

3.3.2 CONTROL AND MONITORING

Controls, alarms, and indicators associated with the LNAs will be extended to the control building and appropriate items further extended to the optional auto-dial monitor and control system interface point.

3.3.3 TECHNICAL CHARACTERISTICS

The LNA technical characteristics are summarized in Table 3-1.

3.4 HPA SUBSYSTEM

3.4.1 HIGH POWER AMPLIFIER

COMSAT International proposes to use a C-band, 3.35-kW klystron high power amplifier in a single-ended configuration. The bandwidth of the HPA is 45 MHz which is sufficient to provide reliable operation any place within the 36 MHz transponder band.

The klystron amplifier features a digitally controlled all-solid state low noise regulated beam power supply; solid-state temperature stabilized FET IPA; precision digital panel meters and LED controls and a digitally controlled all solid-state RF drive (gain) attenuator; all packaged in a compact cabinet with optimum accessibility for ease of maintenance.

Table 3-1. Low Noise Amplifier Technical Characteristics

Frequency Range	3.7 to 4.2 GHz
Gain	60 dB
Gain Flatness	±0.5 dB
Noise Temperature	35°K max
Output Power @ 1 dB Compression	+10 dBm
Intermodulation (3rd Order)	60 dBc 2 CXRs each @ 62 dBm input
Input VSWR	1.3:1 max
Output VSWR	1.3:1 max
Input/Output Connections	Input - CPR 229G Output - type N-coaxial
Power Consumption	Operating 500W Start Up 1000W
Group Delay/40 MHz - Linear - Parabolic - Ripple	±0.1 ns/MHz (max 0.01 ns/MHz^2 (max) 0.3 ns pp (max)
Out of Band Signal Levels	The LNA shall deliver the specified performance when operated in the presence of input signals of -10 dBm in the 5925-6425 MHz range.

3.4.2 CONTROL AND MONITORING

Status signals and control functions associated with the HPA will be extended to the optional auto-dial monitor and control system interface point.

3.4.3 TECHNICAL CHARACTERISTICS

The HPA technical characteristics are summarized in Table 3-2.

3.5 UP-CONVERTERS

3.5.1 GENERAL

COMSAT International proposes a single ended dual-conversion up-converter subsystem. The converter is self-contained including power supply, gain slope and group delay equalization and integral status/alarm circuits. The use of a two stage IF to RF conversion technique, offers improved spurious protection, minimized local oscillator leakage and reduced noise.

The use of modular, solid state construction in the design of these units provides for the highest level of mission availability, ease of maintenance and simplified operation. The RF output is automatically muted if an out-of-lock condition occurs in either the IF or local oscillators.

Table 3-2. Klystron High Amplifier Technical Characteristics

Frequency Range	5850 to 6425 GHz
Power Output (Nominal)	64.8 dBm at Cabinet Flange
Gain at Rated Power	77 dB
Bandwidth - 1 dB	45 MHz
Gain Stability at Constant Temp.	±0.25 dB/24 Hr
Gain Variation vs Frequency	0.4 dB p-p max, Fo ±13 MHz
Gain Slope vs Frequency	±0.02 dB/MHz, Fo ±6 MHz
VSWR Input/Output	1.2:1
Load VSWR	2.0:1 max for full spec. compl.
Harmonic Output With Filter Without Filter	-80 dBc (all) -55 dBc (2nd), -50 dBc (3rd)
Noise and Spurious: (at rated small signal gain excluding harmonics)	-70 dBw/4 kHz 5850 to 6425 MHz -135 dBw/4 kHz 3625 to 4200 MHz -110 dBw/1 MHz 4.2 to 40 GHz
Intermodulation Products	-30 dBc for total power of two equal carriers at 7 dB b/o below rated power
Group Delay (Any 36 MHz transponder band)	
Linear	±0.25 nsec/MHz
Parabolic	0.05 nsec/MHz^2
Ripple	2.0 nsec p/p

Table 3-2. Klystron High Amplifier Technical Characteristics (Cont')

Prime Power	120/208 VAC ±10% 3 Ø plus neutral and (5-wire) 50-60 Hz ±5% 12 kVa max
Power Factor	0.9 min
In-rush Current	175% of full load (max)

The use of external test equipment is facilitated by front panel connectors that provide monitoring points for the IF input, RF output and the IF and RF local oscillators. The IF input to the converter is fed from the rear of the unit through a front panel coaxial u-link which can be disconnected to provide access for local IF testing. Summary alarm information for remote applications is provided by a rear panel connector.

3.5.2 TECHNICAL CHARACTERISTICS

The up-converter technical characteristics are summarized in Table 3-3.

3.6 DOWN-CONVERTERS

3.6.1 GENERAL

COMSAT International proposes a single ended, dual-conversion down-converter subsystem. The converter is self-contained including power supply, gain slope and group delay equalization and integral status/alarm circuits. The use of a two stage RF to IF conversion technique offers improved spurious protection minimized local oscillator leakage and reduced noise.

The use of modular, solid state construction in the design of these units provides for the highest level of mission availability, ease of maintenance and simplified operation.

Table 3-3. Up-Converter Technical Characteristics

Type	Dual Conversion
Frequency Selection	5925 to 6425 MHz
Frequency Stability	$\pm 1 \times 10^{-6}$/Month
Noise Figure	20 dB
IF Input	
Frequency	70 MHz ±18 MHz
Level	-15 to -45 dBm
Impedance	75 ohms
Return Loss	23 dB
RF Output	
Frequency	5.925 to 6.425 MHz
Level	+5 dBm nominal
Impedance	50 ohms
Return Loss	20 dB
Input to Output	
Gain	25 dB
Compression	+15 dBm at 1 dB
3rd Order Intercept	+24 dBm min.
Amplitude Ripple	±0.2 dB/36 MHz
Gain Slope	0.05 dB/MHz
Delay Linear	±0.05 ns/MHz
Parabolic	0.005 ns/MHz^2
Ripple	±0.5 ns peak
Stability	±0.25 dB/day
Input Power	115 VAC, 50-60 Hz, ±3 Hz Single Phase, 75 VA nominal

The use of external test equipment is facilitated by front panel connectors that provide monitoring points for the RF input, IF output and IF and RF local oscillators. The IF output of the converter is fed to the rear of the unit through a front panel coaxial u-link which can be disconnected to provide access for local IF testing.

Summary alarm information for remote applications is provided by a rear panel connector.

3.6.2 TECHNICAL CHARACTERISTICS

The up-converter technical characteristics are summarized in Table 3-4.

3.7 SCPC EQUIPMENT

3.7.1 15-kHz PROGRAM AUDIO

COMSAT International proposes a frequency agile, single-channel-per-carrier FM terminal for satellite transmission and reception of high quality audio, voice or data. The SCPC technique provides the user with direct access to satellite circuits from any location without having to combine with other channels. Each modulator/demodulator is a self-contained plug-in unit (4 plug-ins plus power supply/shelf).

Table 3-4. Down-Converter Technical Characteristics

Type	Dual Conversion
Frequency Selection	5925 to 6425 MHz
Frequency Stability	$\pm 1 \times 10^{-6}$/month
Noise Figure	17 dB max
RF Input	
Frequency	3.7 to 4.2 GHz
Level	-70 to -30 dBm
Impedance	50 ohms
Return Loss	23 dB
IF Output	
Frequency	70 MHz, $\pm$ 18 MHz
Level	0 to -40 dBm
Impedance	75 ohms
Return Loss	20 dB
Input to Output	
Gain	30 dB nominal
Compression	+15 dBm @ 1 dB
3rd Order Intercept	+25 dBm min.
Amplitude Ripple	0.2 dB $\pm$10 MHz 0.4 dB $\pm$18 MHz
Gain Slope	0.05 dB/MHz
Delay Linear	$\pm$0.10 ns/MHz
Parabolic	0.005 ns/MHz^2
Ripple	$\pm$0.5 ns PK
Stability	$\pm$0.25 dB/day
Input Power	115 VAC, 50-60 Hz, $\pm$3 Hz Single Phase, 75 VA nominal

3.7.1.1 Modulator

The modulator accepts wideband audio signals (50 Hz to 15 kHz), compresses their dynamic range and uses the resultant signals to frequency modulate an internally generated RF carrier. The modulated carrier, in the 52-88 MHz range, is summed with the remaining SCPC carriers (not including 60 kHz) and the video carrier and is then used as the input to a commonly used C-band up-converter. Each modulator unit contains an adaptive energy dispersal network to prevent energy concentrations at or near the carrier frequency and reduce the effect of intermodulation interference between carriers in the transponder. Each modulator also contains a frequency stabilization network to maintain exact carrier frequency. An internal frequency sysnthesizer is used to provide a selection of up to 360 standard channels (in 100 kHz increments) throughout the 52-88 MHz spectrum.

3.7.1.2 Demodulator

Each demodulator unit is supplied in a single-ended configuration. The demodulator accepts RF signals from the earth station down-converters and selects the appropriate carrier from among those in the 52-88 MHz range. After demodulation, the signals are expanded to reproduce the orginally transmitted material. The demodulator features a patented phase-lock loop detector to provide threshold extension and exceptional performance in high noise environments.

Specifications for a 15 kHz program terminal are provided in Table 3-5.

3.7.2 ORDERWIRE

The orderwire system will also be configured as a single-channel-per-carrier system. COMSAT International proposes to use the same type of equipment used for the 15 kHz program channels above except the bandwidth will be reduced to 8 kHz. This unit will then fit into the same mainframe and be controlled by the same type auto switching environment as used for the 15-kHz program channels. A one-to-one redundant configuration will be used for the modulator and a single-ended configuration for the demodulator.

3.7.3 WIDEBAND SCPC

3.7.3.1 Wideband SCPC Exciter

In order to provide the relatively wide baseband frequency capability that COMSAT International understands is required for this carrier (60-128 kHz), COMSAT International proposes to use a standard INTELSAT quality message modulator. However, for operational considerations, there is also a requirement to have the capability of individually moving the RF carriers to different locations within the spacecraft transponder band. Since the output frequency of the proposed modulator is

Table 3-5. 15-kHz SCPC FM Terminal Technical Characteristics

Audio Interface	
Input/Output	
Frequency Range	50 Hz to 15 kHz
Average Program Level	+8 dBm
Peak Program Level	+18 dBm
Impedance	600 ohm balanced
Audio Characteristics	
Frequency Response (1 kHz ref)	
50 Hz to 125 Hz	+0.4 to -0.8 dB
125 Hz to 10 kHz	±0.4 dB
10 kHz to 15 kHz	+0.4 to -0 dB
Modulator Characteristics	
Input Frequency Range	50 Hz to 15 kHz
Output Frequency Range	52 to 88 MHz
Peak Carrier Deviation (+18 dBm)	±75 kHz
Deviation Capability	±100 kHz @ 1% linearity
Input Level	+12 to 18 dBm PPL -2 to +9 dBm APL
Output Level	-10 dBm
Output Impedanced	75 ohms
Level Stability	±0.2 dB/24 Hrs
Frequency Stability	$\overline{3} \times 10^{5}$ (0°C to +51°C)
Operating Channel Spacing	300 kHz minimum
Energy Dispersal	3.75 Hz ± 1% sinusoidal at 40 kHz peak dev.

Table 3-5. 15-kHz SCPC FM Terminal Technical Characteristics (Cont')

Demodulator Characteristics	
Input Frequency Range	52 - 88 MHz
Output Frequency Range	50 Hz to 15 kHz
Impedance	75 ohms
Input Level	-65 to -20 dBm
Output Level	+12 to +18 dBm PPL -2 to +9 dBm APL
Adjacent Channel Selectivity	65 dB
Operating Channel Spacing	300 kHz min.
Signal-to-periodic Noise Ratio	67 dB max.
AFC	±80 kHz
Power Requirements	
Standard	115 VAC ±10 % 57/63 Hz
Dimensions	
Shelf (Accepts power supply and 4 plug-ins in any comb.)	8.75 x 18 x 19 inches
Frequency Agility	Thumbwheel frequency selection 100 kHz steps

centered at 70 MHz and is not readily adjustable, COMSAT International proposes to add an additional RF up-converter which will provide the required uplink frequency flexibility. The up-converter will be a frequency agile type adjustable in 125-kHz increments by front panel thumbwheel switches. The modulator is supplied in a redundant configuration whereas the up-converter is not.

3.7.3.2 Wideband SCPC Receiver

An INTELSAT quality FM demodulator and down-converter compatible with the above uplink system will be provided. The down-converter will be a frequency agile type adjustable by mean of front panel thumbwheel switches over the 3.7 to 4.2 GHz range.

3.7.3.3 Technical Characteristics

Technical characteristics for the wideband SCPC exciter are provided in Table 3-6 and those for the wideband SCPC receiver are provided in Table 3-7.

Table 3-6. Technical Characteristics for a Wideband FM SCPC Exciter

Modulator	
Baseband Input	
Frequency	4 kHz to 156 kHz
Impedance	75 ohms
Level	-20 dBm
Return Loss	26 dB, 8 kHz to 8.2 MHz 17 dB, 4.3 kHz to 8 kHz
Preemphasis	Per CCIR Rec 464
IF Output	
Frequency	70 MHz
RMS Deviation	300 kHz Nominal
Level	0 dBm Nominal
Impedance	75 ohms
Return Loss	23 dB
Frequency Stability	±10 kHz/year
Up-Converter	
IF Input	
Frequency	70 MHz ±18 MHz
Level	0 to -20 dBm
Impedance	75 ohms
Return Loss	23 dB
RF Output	
Frequency	5925 to 6425 MHz
Level	-10 dBm Nominal
Impedance	50 ohms
Return Loss	20 dB

Table 3-6. Technical Characteristics for a Wideband FM SCPC Exciter (Cont')

Input to Output	
Gain	-10 to +10 dB
Compression	0 dBm @ 1 dB
3rd Order Intercept	+5 dBm min.
Frequency Stability	1×10^{-6}
Amplitude	0.2 dB ±10 MHz
Slope	0.05 dB/MHz
Exciter Input Power	115 VAC ±10%, 47 to 63 Hz Single Phase, 95 VA Nominal

Table 3-7. Technical Characteristics for a Wideband FM SCPC Receiver

Down-Converter	
IF Output	70 ±18 MHz
Level	0 dBm to -40 dBm
Impedance	75 ohms
Return Loss	20 dB
RF Input	
Frequency	3.7 to 4.2 GHz
Level	-30 to -70 dBm Nominal
Impedance	50 ohms
Return Loss	23 dB min
Noise Figure	17 dB max
Input to Output	
Conversion Gain	+30 dB Nominal
Compression	+15 dB @ 1 dB compression
3rd Order Intercept	+25 dBm min
Amplitude ±0.6 MHz	±0.1 dB
±18 MHz	±0.2 dB
Gain Slope	0.05 dB/MHz
Group Delay	
Linear	±0.1 ns/MHz
Parabolic	0.005 ns/MHz
Ripple	1 ns ppk
Frequency Stability	$\pm 1 \times 10^{-6}$

Table 3-7. Technical Characteristics for a Wideband FM SCPC Receiver (Cont')

Demodulator	
IF Input	
Center Frequency	70 MHz
Level	0 to -40 dBm
Impedance	75 ohms
Return Loss	23 dB
Baseband Output	
Frequency	4 kHz to 156 kHz
Impedance	75 ohms
Level	-20 dBm
Linearity	1.5%
Preemphasis	Per CCIR Rec. 464
Receiver Input Power	115 VAC ±10%, 47 to 63 Hz Single Phase, 95 VA Nominal

3.8 TELEVISION EQUIPMENT

3.8.1 GENERAL

COMSAT proposes to use a fixed frequency (70 MHz) video modulator/demodulator system. The 70 MHz carrier is FM modulated by a video input signal before being combined with the 15 kHz orderwire/SCPC signals and then used as the input to a common C-band up-converter.

In addition to the video signal, the 70 MHz video carrier is also FM modulated by an audio subcarrier with a switchable frequency of either 6.6 or 6.65 MHz. The subcarrier oscillator is FM modulated by an audio signal in the 40 to 15 kHz range. This system is compatible with NTSC, PAL and SECAM video formats.

The video/audio modulator is supplied in a redundant configuration whereas the demodulator is not.

3.8.2 CONTROL AND MONITORING

Status signals and control functions associated with the television subsystem will be extended to the optional auto-dial monitor and control system interface point.

3.8.3 TECHNICAL CHARACTERISTICS

The television subsystems technical characteristics are summarized in Table 3-8.

Table 3-8. Television Subsystem Technical Characteristics

Video Modulator	
Baseband Frequency	20 Hz to 8 MHz
Preemphasis	CCIR Rec. 405-1
Level	IV p-p
Level Stability	±0.2 dB/day
Impedance	75 ohms
Return Loss	26 dB min.
Peak Deviation	Up to 12 MHz
Energy Dispersal Frequency	25/30 Hz
IF Output	2 MHz p-p without video 70 MHz
Video Demodulator	
Video Format	525 or 625 lines
Baseband Frequency	20 Hz to 8 MHz
Deemphasis	CCIR Rec. 405-1
Baseband Level (Composite Video)	Adjustable IV p-p
Impedance	75 ohms
Return Loss	26 dB min
Baseband Squelch	Activated by Summary Alarm
IF Input	70 MHz
Audio Subsystem	
Interface	
Frequency	40 - 15 kHz
Impedance	600 ohms bal
Av. Program Level	0 dBm
Peak Program Level	+9 dBm

TABLE 3-8. Television Subsystem Technical Characteristics (Cont')

Emphasis Type	CCIT Rec. J.17
Subcarrier Frequency	6.6 or 6.65 MHz Selectable
Peak Deviation @ Av. Program Level	±150 kHz
Peak Deviation @ Peak Program Level	±423 kHz

3.9 TERRESTRIAL LINK EQUIPMENT

The microwave link equipment is divided into two major sections. The first is the baseband processing equipment which is the program channel modulator/demodulator and the service channel converter. The second section is the RF section which involves the combiners, up-converters, power amplifier, low noise receiver, the antenna, and associated waveguide.

3.9.1 PROGRAM CHANNEL MODULATOR/DEMODULATOR

The program channel modulator/demodulator provides the ability to insert audio subcarriers above the video channel in conventional microwave relay systems. This system permits up to four 15-kHz audio subcarriers to be added to each video carrier and meets the RS-250B and CCIR standards.

Alarm functions are provided that include a front panel LED indicating a failure in any of the four channels and a summary fault contact closure indicating a subcarrier loss or power supply loss.

Technical Specifications

Modulator

Input Level (@ 75 kHz deviation)	+8 dBm	(Range 0 to +18)
Impedance	600 ohm balanced	

Technical Specifications (Cont')

Return Loss	26 dB	
Pre-Emphasis	75 us	(Optional 50 us)
RF Subcarrier Output	FM	
Level (p-p)	100 mV	(Range 50-150 mV)
Impedance	High Z	(Average 1.5 K)
Deviation (1 kHz TT)	75 kHz	
Demodulator		
Output Level (@ 75 kHz deviation)	+8 dBm	(Range 0 to +18)
Impedance	600 ohm balanced	
Return Loss	26 dB	
RF Subcarrier Input	FM	
Level (P-P)	100 mV	(Range 50-150 mV)
Impedance	High Z	
Back-to-Back Performance		
Frequency Response (Ref. 1 kHz @ 20 dB below TT)		
40 Hz to 100 Hz	+.5 to -1.0 dB	
100 Hz to 7.5 kHz	$\pm$.5 dB	
7.5 kHz to 15 kHz	+.5 to -1.5 dB	

Technical Specifications (Cont')

Distortion (THD @ 75 kHz Dev.)	1%	
Signal to Noise Ratio	70 dB	(Ref. 75 kHz Dev.)

3.9.2 SERVICE CHANNEL CONVERTER

The Service Channel Converter enables a range of facilities to be provided above the video and audio subcarriers on a microwave system. This unit is a complete single sideband suppressed carrier device that will permit parallel connection of orderwire and the 60-kHz wideband channels. The unit has the capacity to handle two .3- to 12-kHz channels and a single 16- to 130-kHz channels. For FBIS system, only Channel 1 (12 kHz) and Channel 3 (60 kHz) will be used.

Technical Specifications

Transmit/Receive Side	
Bandwidth Channel 1	.3 to 12 kHz
Bandwidth Channel 3	16 to 130 kHz
Impedance Channel 1	600 ohms balanced
Impedance Channel 3	75 ohms unbalanced
Channel 1 Level	-14 dBm (nominal)

Technical Specifications (Cont')

Channel 3 Level	-20 dBm (nominal)
Channel 1 Connector	Barrier Strip
Channel 3 Connector	BNC Connector
Back-to-Back Performance	
Frequency Response, Channel 1	±1 dB
Frequency Response, Channel 3	±.5 dB/4 kHz (±1 dB Total)
Signal to Noise, Channel 1	60 dB
Signal to Noise, Channel 3	55 dB (Estimated)
Harmonic Distortion	1%
Frequency Stability	$\pm 1 \times 10^{-7}$ (+10 to 40 Deg. C)

3.9.3 TRANSMITTER/RECEIVER UNIT

This unit is a totally solid-state, frequency modulated, wideband microwave system designed for use in the common carrier bands of 18 GHz an 23 GHz.

The transmitter section contains the required video modulator and baseband combining networks that will accept video or message formats for processing and impressing upon an internally generated microwave carrier for frequency modulation at the assigned transmitter frequency. Two carriers will be transmitted for the FBIS radio link, the first carrier will contain one video carrier, four each 15-kHz Program Audio

Subcarriers, while the second carrier will contain three each 15-kHz Audio Subcarriers, one each 3-kHz orderwire channel and the 60-kHz channel.

The receiver is a dual channel, super-heterodyne, microwave unit which processes frequency-modulated microwave signals and has four outputs.

The transmit/receive system obtains its required power from a common external regulated power supply that can receive wide input variations and still deliver precisely regulated voltage levels to the transmitter and receiver. This will greatly increase component longevity.

Technical Specifications

Transmitter	
Deviation	±4 MHz
Frequency Stability	±.005% (-30 to +55 Deg. C)
Baseband Video Level	1 V p-p
Impedance	75 ohms unbalanced
Return Loss	26 dB
RF Power Output	+30 dBm
Receiver	
RF Bandwidth	34 MHz
RF Return Loss	26 dB
IF Frequency	70 MHz

Technical Specifications (Cont')

IF Bandwidth	30 MHz
IF Return Loss	26 dB
BB Video Level	1 V p-p
BB Impedance	75 ohms unbalanced
BB Return Loss	26 dB
Noise Figure	8.5 dB
Threshold	-79 dBm (for 37 dB S/N)
Back-to-Back Amplitude vs Frequency Response	
10 kHz to 300 kHz	±.15 dB Maximum
300 kHz to 5 MHz	±.25 dB Maximum
5 MHz to 8 MHz	±.5 dB Maximum
Chrominance Luminance Gain Inequality (RCL)	±1 IRE Unit Maximum
Delay Inequality (RCD)	±20 ns Maximum
Waveform Distortion Field Time (FD)	3 IRE Units (Clamped Output)
Line Time (LD)	1 IRE Unit
Short Time (SD)	4 IRE Units
Differential Gain	2% Maximum
Differential Phase	.2 Degree Maximum

Technical Specifications (Cont')

Signal-to-Noise	60 dB Minimum (10 Hz to 10 kHz)
Signal-to-Noise	70 dB Minimum (10 kHz to 5 MHz)
Power Consumption	
Transmitter	200 Watts
Receiver	100 Watts

3.9.4 ANTENNA AND WAVEGUIDE

Several different sizes and frequency band antennas will be used for the microwave link. A three-hop system is required for the Quantico site.

Typical Antenna Performance

Rosslyn	2 Feet	23 GHz	40.0 dBi gain
Repeater	4 Feet	18 GHz	44.5 dBi gain
Repeater	8 Feet	6 GHz	41.5 dBi gain
Earth Station	6 Feet	6 GHz	38.9 dBi gain

The waveguide used for this system will be pressurized to prevent moisture from entering the RF path.

3.10 EXPANSION

Provision has been made in the size of the equipment areas, equipment layout and power subsystem to allow for expansion to the capacity specified in the RFP. COMSAT proposes a waveguide switch be installed at the output of the HPA subsystem as shown on the transmit block diagram, Figure 2-3. This will allow the addition of a high power combiner and HPA(s) without any significant interruption in traffic.

Multiport transmit and receive dividers with spare ports for addition of low level carriers (i.e., 15 kHz) have also been provided.

In addition to the additional transmit and receive equipment, a second transponder would also be required to meet the additional traffic handling capabilities described in the RFP.

3.11 TEST EQUIPMENT

COMSAT International recommends the following test equipment as part of the earth station complex. The equipment will be used in operation and maintenance of the earth station. The equipment listed is based on minimal operational requirements. Additional test equipment is available from COMSAT International's operations and maintenance facilities.

	Quantity
Spectrum Analyzer	1
Frequency Counter	1
RMS Voltmeter	1
Baseband Signal Generator	1
Wave Analyzer	1
Oscilloscope	1
Digital Multimeter	1
Pattern Generator W/Plus-ins*	1
Waveform/Monitor/Vectorscope*	1
Audio Monitor	1
TV Monitor	1
RF Power Meter	1
Probes, Test Leads, Test Cables, Adapters, etc.	1 lot
RF Signal Generator	1
Tool Kit	1

* For use with PAL, SECAM and NTSC standards.

4. FACILITIES

4.1 GENERAL

The station layout is shown in Figure 4-1. The station will be designed and implemented to provide continuous geostationary arc coverage between the limits of 18.5°W longitude and 53°W longitude. Station facilities include the main building and its utilities, and the site proper with access road, parking, security fence, and provisions for the earth station antenna and microwave tower. Included, in addition, is the clearing of 1-3/4 acre of trees lying outside the existing fence line to provide clear access to the geostationary arc.

4.2 SITE INVESTIGATION

The site will be surveyed to accurately establish the location of existing man-made and natural features. A drawing defining these features and their pertinent dimensions will be prepared.

Soil tests and borings will be made to assure soil strength and stability. The proposal is based on obtaining 2,000 psf allowable soil bearing strength at a foundation depth 30 inches below grade, and a high degree of stability.

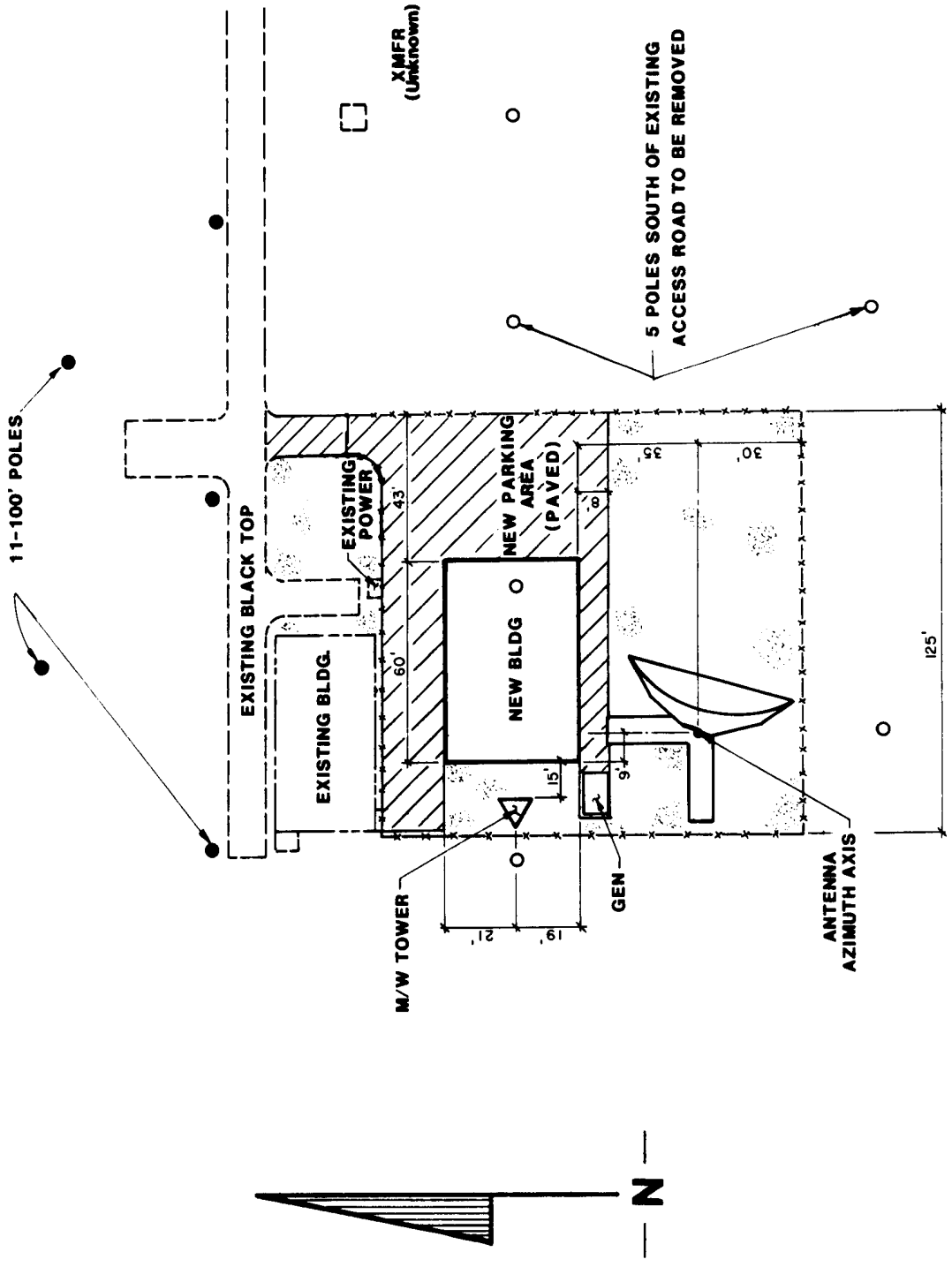


Figure 4-1. Site Layout FBIS Quantico

4.3 SITE CLEARING AND PREPARATION

Sufficient clearing of trees to the east and south of the developed site is included to ensure that performance requirements are met within the operational arc. The precise requirements for off-site clearing are established by computer analysis which has shown that, based on level grounds, about 1-3/4 acres of land outside the existing fence must be cleared. The disposition of the cleared trees and brush will be established during negotiations.

In addition to the clearing of trees, six of eleven existing wooden poles inside the site will be taken down. The developed site will consist of approximately 15,600 square feet within the existing fenced area. The building, earth station antenna, terrestrial microwave tower, and paved parking facilities for four automobiles will lie within this area. Areas within the developed site that are not designated for specific purposes will be seeded with grass. The entire developed site will be enclosed within a new chain-link fence. A manually operated vehicular gate is included.

4.4 BUILDING

4.4.1 GENERAL

The building will be a 40-foot by 52-foot structure, 14 feet high, containing an equipment room for both terrestrial and earth station equipment, an electronic maintenance shop, an

office, a reception area, kitchen, men's and women's washrooms, a custodial closet and a utility room for the air-conditioning equipment and water heater. The building layout is shown in Figure 4-2. Note that neither the battery room nor the equipment associated with the UPS, both of which are shown in Figure 4-2, form part of the basic COMSAT International proposal described here, but are offered under a Facilities Option described in Section 7 of the proposal.

4.4.2 STRUCTURE

The building is of block construction and has non-structural internal walls. The roof is a membrane type. Roofing pavers will be utilized at one end of the roof, if required, for protection from ice that might fall from the microwave tower. Gravel ballast will be used elsewhere. The roof is supported by 24-inch open web full span joints. The floor is a 4-inch slab.

4.4.3 FINISHES

A suspended ceiling will be provided in the office, kitchen, washrooms, reception area and corridor. The clear height below the ceiling will be eight feet. In the other rooms, the overhead will be painted flat black.

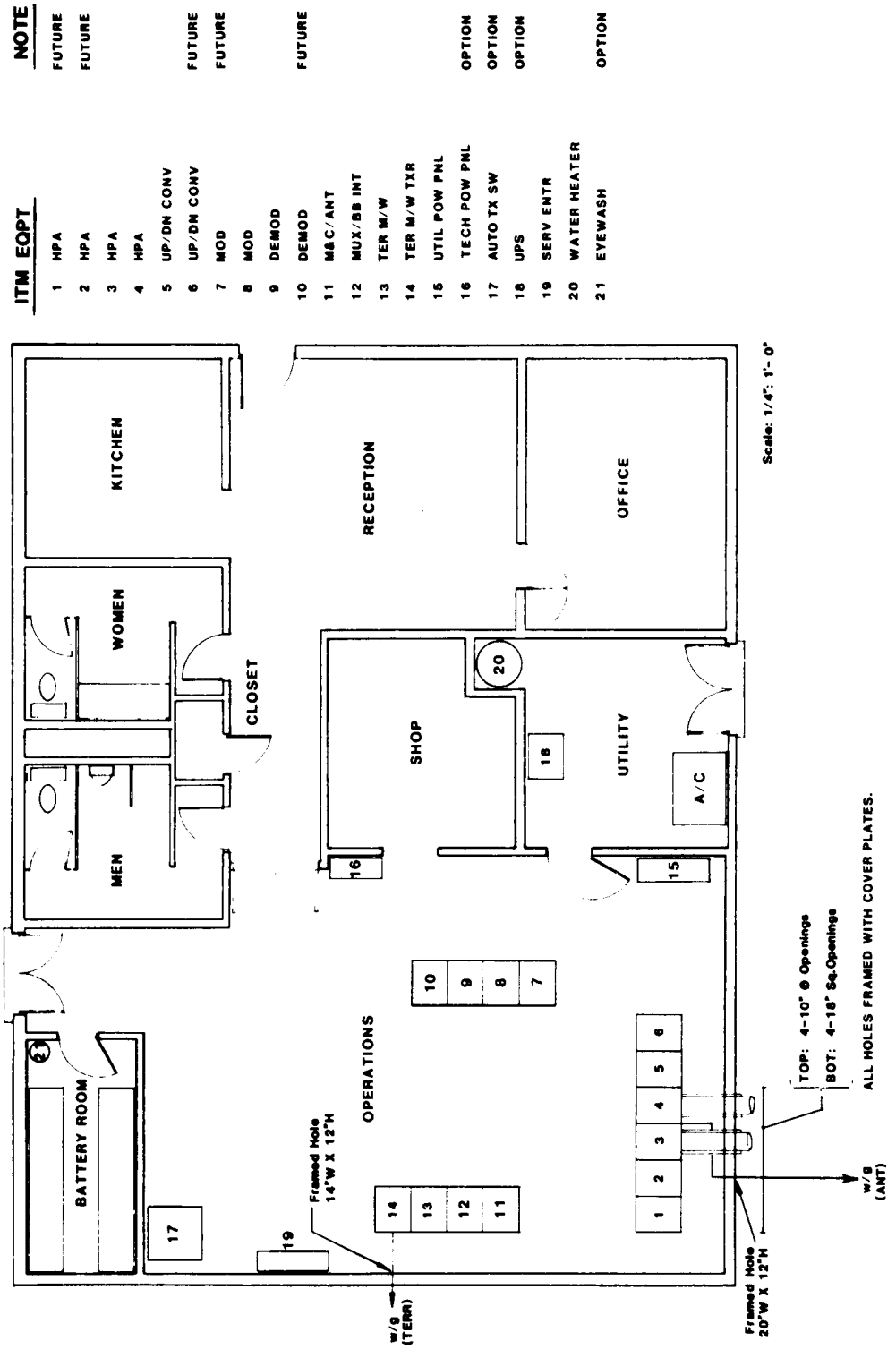


Figure 4-2. Floor Plan FBIS Quantico

Floors will be finished with vinyl tile in all rooms except the utility room which will have painted concrete, and the washrooms which will have ceramic tile floors and bases.

The exterior block walls will be painted inside and out. The interior non-structural walls will also be painted. Men's and women's vanities are included in the washrooms.

The kitchen will include a sink, counter top, shelves and cupboards. No appliances are included under the basic proposal.

4.4.4 UTILITIES

The station utilities will be sized to accommodate all necessary equipment and a 24-hour staffing level of four.

4.4.4.1 HVAC

The HVAC system will provide cool air to the operations and living spaces. Low ambient operating provisions and humidification in winter are included. The evaporator/fan coil unit will be located in the utility room. Conditioned air will be ducted overhead to each room, and returned via the space between the false ceiling and the roof. The office, kitchen, reception area, shop and washrooms will include duct heaters to maintain comfortable conditions in these areas in winter. The compressor will incorporate two circuits, each operating at 60 percent of capacity under maximum cooling

conditions so that in the event of a failure of one circuit, the second will carry the load at full capacity.

4.4.4.2 Water

The building will be connected to the existing water system. It is assumed in this proposal that a standard hook-up can be made within five feet of the building. No provisions have been made for chlorination or other treatment of the water. An electric water heater is included.

4.4.4.3 Sewage

The building will be connected to the existing sewage system. It is assumed that a standard hook-up can be made within five feet of the building.

4.4.4.4 Power

Electric power will be distributed throughout the station at 208 volts AC three phase via a 400A panelboard equipped with a 400A main circuit breaker. It is assumed that a standard hook-up can be made within five feet of the building. Electric utility service will be supplied directly to the panelboard main breaker, which will serve as the utility service disconnect. Branch circuit breakers will be supplied to feed the station loads according to the schedule shown below:

Breaker Size	Load Served
3P50A	HPA
3P50A	Future HPA
3P30A	HVAC #1
3P30A	HVAC #2
1P20A	Lighting
1P20A	Lighting
1P20A	Receptacles
1P20A	Receptacles
1P20A	Up/Down-Converter
1P20A	Modulator
1P20A	Demodulator
1P20A	Microwave Transmit
1P20A	Microwave Receive
1P20A	Baseband Interface
1P20A	LNA
1P20A	Antenna Control Unit
1P20A	Dehydrator
1P20A	Fire Protection System

All wiring and equipment installation will be accomplished according to the 1984 edition of the National Electric Code and accepted industry practice. We contacted the Quantico Marine Base Engineer's office regarding the "Quantico Base Building Code," but were advised that no such exists. All materials and equipment will conform to applicable industry standards such as ANSI, NEMA, and IEEE and will be UL-listed when listing is applicable. Light fixtures will be flourescent,

and all wiring devices will be specification grade. Conductors will be THHN copper in EMT or rigid conduit.

Conductors feeding equipment racks and HPA's will be run in 2-1/2" X 2-1/2" metal wireway with hinged covers to facilitate access and expansion.

4.4.4.5 Fire Protection

Smoke defectors will be installed in every room and interconnected to the alarm system which will activate alarm bells in the electronics equipment room, reception area and kichen. Fire extinguishers will all be of the same type (Halon) to ensure against inadvertent damage to equipment.

4.4.4.6 Site Security

The site will be enclosed within a new 8-foot high chain link fence with three strands of barbed wire. A manual vehicular gate with lock is included.

4.5 FBIS-FURNISHED SERVICES

It is assumed that the following services will be provided by FBIS for the integration of the communication system:

At Quantico:

a. Land and serviceable utility interfaces within five feet of building at Quantico Marine Base.
b. Water Supply: 300 gallons per day, 30 psig at 30 GPM flow rate.
c. Sewage System: Equal to projected station staffing level.
d. Power: 208V, 3 PH, 4W approximately 70 kVA demand.
e. Access: Access to site as needed by COMSAT personnel.

At Rosslyn:

a. Floor space (100 square feet) at Rosslyn headquarters.
b. Space on building rooftop for microwave antenna installation.
c. Conveyance system for waveguide interconnect between the antenna and the equipment room.
d. AC power for electronics (2 kW at 115 VAC).
e. HVAC for the equipment room.
f. Provide signal interface cables between customer equipment and COMSAT Interface Panel.
g. Local access to the roof top equipment room and Quantico Marine Base.

The choice of where to locate the earth station within the overall site was based on limited information and could therefore change when all the pertinent details are available. For the present, it is proposed to locate the earth station south of the access road so that any future development of the site will occur behind the existing facility. This avoids any potential for blockage of the RF path by construction equipment etc., working on the site. It is also preferable to route the access road so that the earth station is approached from behind the antenna. Then, the need to loop the access road out so that large vehicles can pass underneath the RF beam without interfering with it is avoided. The above requirements can be satisfied in other ways if needed with only minor impact.

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5. OPERATION AND MAINTENANCE

5.1 OPERATIONS PHILOSOPHY

Customer satisfaction is a COMSAT International commitment. To meet this goal, the operations philosophy is to provide high quality and reliable services tailored to each customer's needs; backed by our corporate management, operational and technical resources to ensure customer satisfaction.

An Operations organization including staff and operating facilities maintains customer services once they become operational and maintains the coordination and control with the customer and other entities providing the service. The Operations organization is given in Figure 5-1.

COMSAT International proposes, under its basic offer, a nonredundant earth station equipment configuration except for modulator redundancy, with an adequate complement of equipment spares on site at Quantico, utilizing around the clock earth station manning. This manned operation provides the capability of rapid response both to earth station problems and changes in INTERNET network operations as required by FBIS. The complexity of initiating a new service by a new network places demands on the earth station operation which are best met by manned operation of the CONUS INTERNET earth station. Toward the end of the first year of operation, the need for 24-hour manning of the station will be reevaluated by COMSAT International.

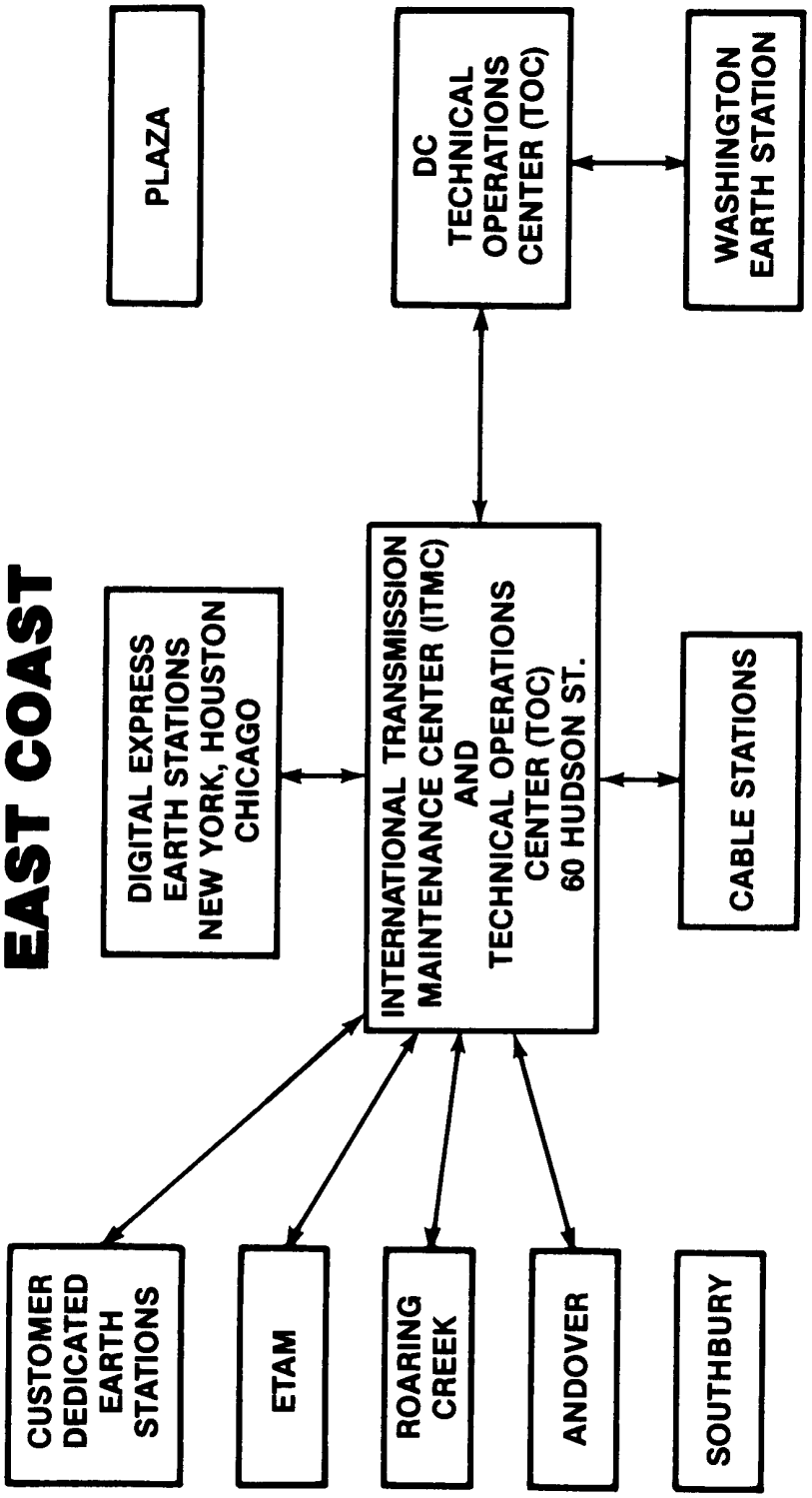

Figure 5-1. International Network Operations

COMSAT International will provide a trained and experienced operation and maintenance staff for the earth station. In support of the station personnel, COMSAT International maintains a maintenance depot in the Washington, D.C. metropolitan area. This depot can provide additional manpower to assist the station staff in resolving operational problems and in maintaining the microwave link to Rosslyn, Virginia, and the equipment on FBIS premises at Rosslyn. In addition to the spares at the site, a centralized east coast parts depot will provide spares to ensure that the required spares for the earth station are available. Circuit maintenance activities will also be supported, as required, by the International Transmission Maintenance Center (ITMC) shown in Figure 5-1, in New York City. Furthermore, COMSAT International maintains a dedicated engineering staff at its headquarters who are available to support the on-site and depot maintenance personnel.

Around the clock operation of the ITMC will be provided. ITMC personnel will be familiar with international contact points and protocols to provide rapid and efficient end-to-end coordination and fault resolution in accordance with CCITT recommendations and other specialized procedures such as will be developed for FBIS services.

The ITMC reports to the Director of Central Office Operations (COO) located at COMSAT International headquarters in Washington, D.C. The Director of Central Office Operations maintains oversight of these facilities and has available appropriate resources in order to monitor and evaluate the performance of all COMSAT International network services.

Central Office Operations will provide the necessary service information and interface with others in performing network maintenance.

5.2 NETWORK MANAGEMENT

Network management as provided by COMSAT International is custom tailored to FBIS needs. The service demarcation point will be at a patch panel/test facility maintained by COMSAT International at the FBIS headquarters facility in Rosslyn, Virginia. Circuit maintenance is discussed in Section 5.3.

5.2.1 FACILITIES IMPLEMENTATION AND OPERATION

During the implementation phase of the initial service, and as part of providing new enhanced capabilities in the future, COMSAT International Central Office Operations will maintain close communications with FBIS to coordinate a smooth implementation of all operational requirements. The operations and maintenance staff at the site at Quantico will provide for the activation/deactivation of the carriers, under the coordination of the ITMC, as directed by FBIS, along with other day-to-day operations of the earth station.

5.2.2 LINE-UP TESTING

Line-up testing is performed by COMSAT International on the terrestrial interconnect facility between FBIS and the station, the on-premise earth station facility, to permit its operation in the INTELSAT system, and on the individual circuits between the demarcation point in Rosslyn with FBIS and the demarcation point on the distant end. These divisions in the testing requirements are shown in Figure 5-2. COMSAT International will coordinate these tests with the distant ends, will conduct the tests at the demarcation point and will report the results to INTELSAT, COMSAT's correspondents and to FBIS.

5.2.3 OPERATIONAL REPORTING

In the event of a service interruption or degradation, FBIS notifies the ITMC* on a toll free number provided for that purpose. The ITMC will maintain coordination with FBIS during circuit maintenance. When the fault has been cleared, the ITMC will report back to FBIS.

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* Because the station is manned, the problems may be noted and corrected without notification from FBIS. As a double safeguard, however, COMSAT International requests that FBIS notify the ITMC whenever FBIS notes a problem.

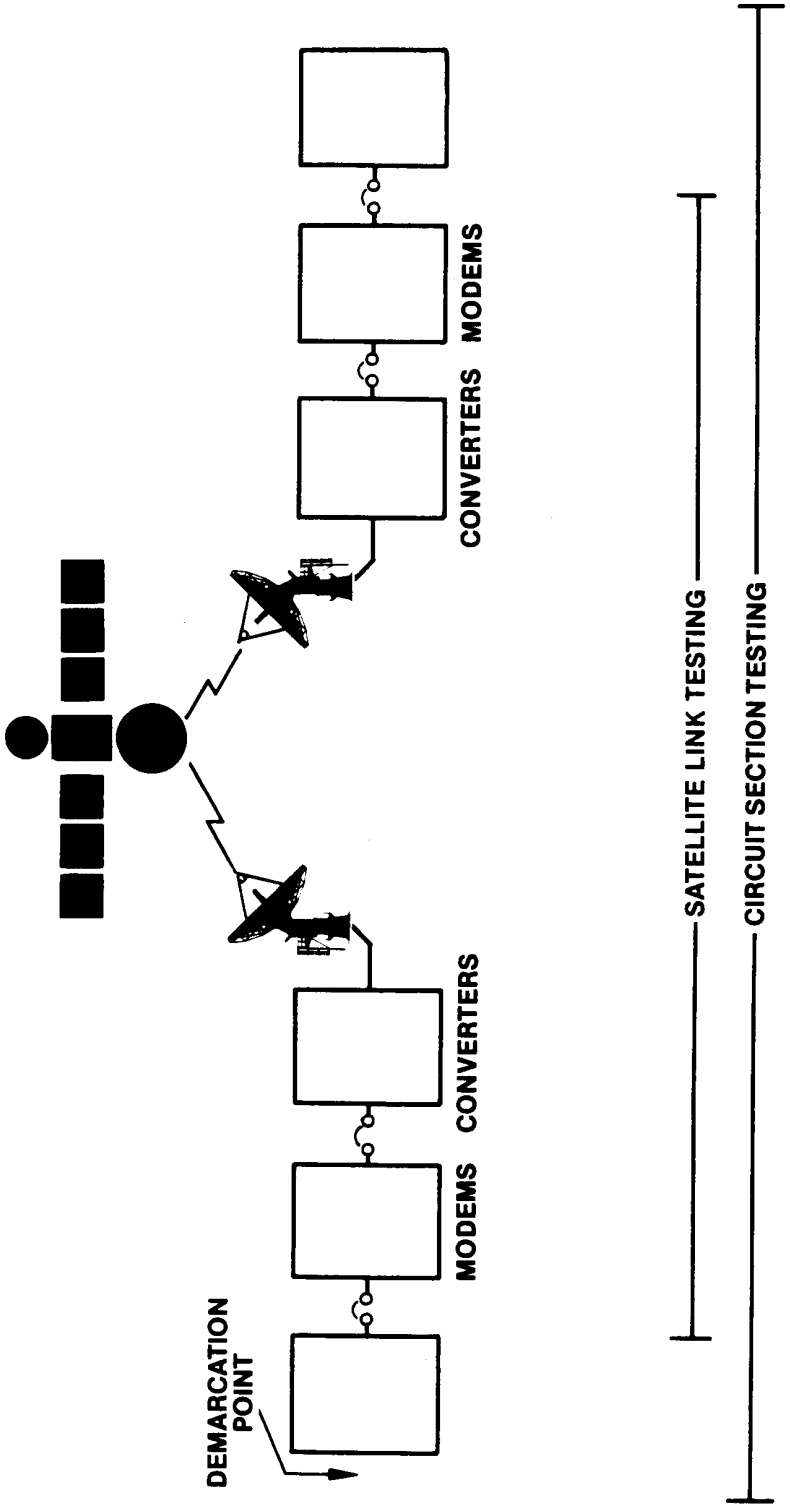

Figure 5-2. Line-Up Testing Sections

COMSAT International has instituted escalation procedures which provide for escalation by the ITMC to the Central Office Operations staff in case of lengthy outages, continuing problems, or other critical conditions. Escalation to Central Office Operations initiates support from headquarters staff or by senior management.

In its capacity as the international service carrier, COMSAT International will maintain all facilities from the demarcation point in the Rosslyn, Virginia, facility to the satellite. COMSAT International will also work with foreign communications entities to quickly resolve any service impairment.

5.3 COMMUNICATION MAINTENANCE

COMSAT International will provide full maintenance service for all communication channels, for the microwave link and the earth station. COMSAT International will be responsible for maintenance between the demarcation point and the satellite, as shown in Figure 5-3. The local maintenance technicians, with the assistance of the ITMC, will arrange for the distant-end station to assist in testing an impaired circuit.

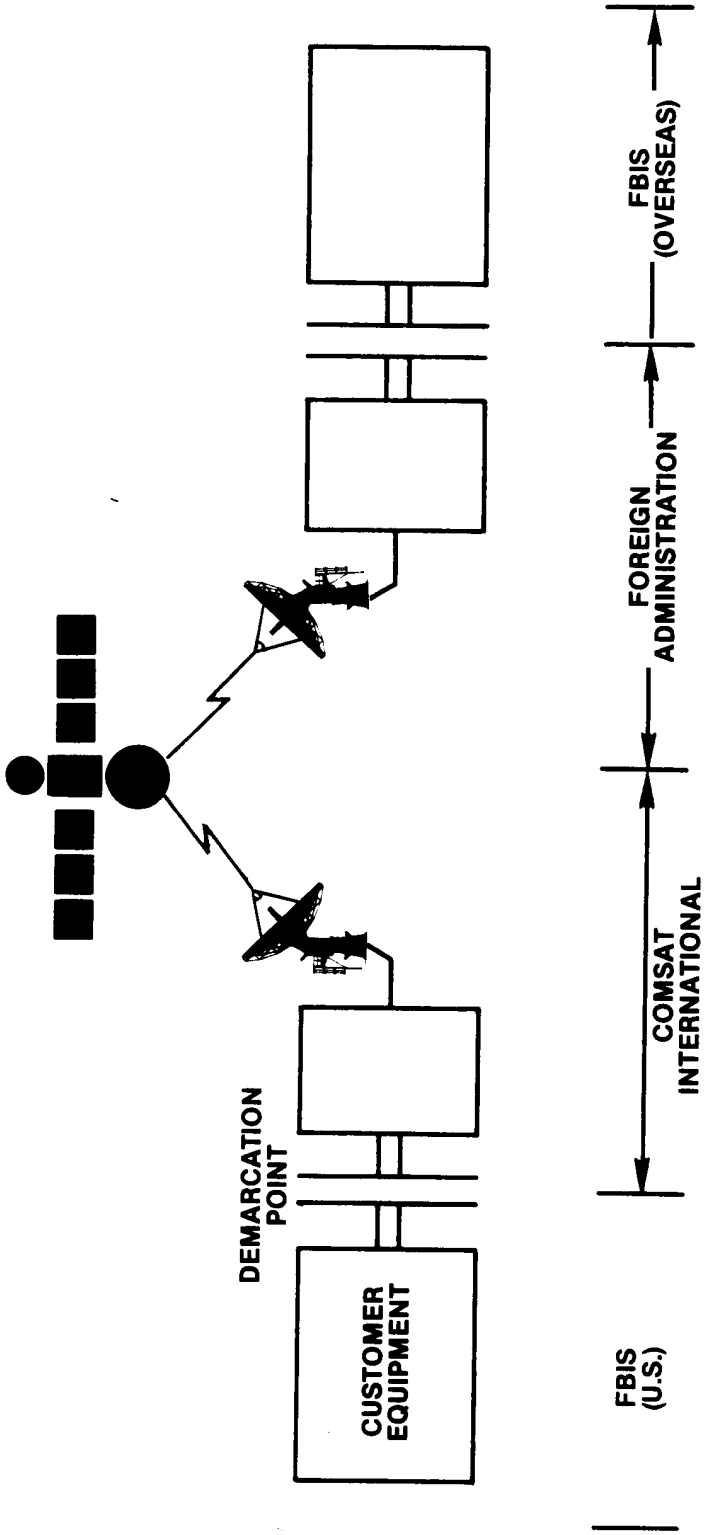

Figure 5-3. Circuit Maintenance Configuration

5.4 MAINTENANCE PHILOSOPHY

Under the fully manned configuration, the operations technicians will patch-in stand-by equipment provided to restore service. Because the technician is on-station, the service interruption is generally quite brief. With automatic redundancy, electronic detectors and switching equipment make this switch-over much more rapidly yielding a higher continuity of service. The station will be equipped with extender boards, tools, test equipment and common components to effect some repairs on site. Many equipment failures will be corrected by shipping in a replacement unit and shipping the failed unit to a maintenance center or to the vendor for repair. The decision on whether to perform local repairs will be based on documentation and parts availability and on the degree of difficulty of the repair. As high service continuity is paramount, time to repair will be an important consideration.

5.5 SPARING

In the following sections sparing is described for each station subsystem. The response time for the depot to provide replacement parts is generally 24 to 48 hours. Expeditious handling may be used to improve these times at COMSAT International's option, depending on the nature of the difficulty.

5.5.1 ANTENNA

The antenna system is not a high failure item. Due to the small aperture size, acceptable signal quality can be obtained over short periods when the drive subsystem or antenna control unit (ACU) is disabled. Restoration in the event of a failure is by manual operation to maintain optimum look angle. Spare parts will be forwarded from the COMSAT International depot facility and, COMSAT International antenna specialists will be brought from an off-site maintenance facility to repair the antenna.

5.5.2 HIGH POWER AMPLIFIER (HPA)

The HPA spares consist of replacement cards and main-frames and are to be stored at the depot facility. The cold stand-by HPA included in the basic station will be used to restore traffic in the event of a failure, while awaiting replacement parts.

5.5.3 LOW NOISE AMPLIFIER (LNA)

The LNA is spared as a unit on station. The failed unit is simply replaced with an identical spare sent from the depot to restore operation.

5.5.4 UP- AND DOWN-CONVERTERS

The up- and down-converters are spared as a unit. A replacement unit is shipped from the depot to replace the one in cold stand-by. The failed unit is not sent for repair until the replacement is on station, checked out, and installed.

5.5.5 MODEMS AND OTHER SIGNAL TRANSLATION EQUIPMENT

Modem repair and the repair of any other signal translation equipment is analogous to the up- and down-converters.

5.5.6 TEST EQUIPMENT

All test equipment is sent to the vendor for repair. Critical test equipment is replaced from the COMSAT International pool during the repair period.

The redundancy switching control devices, where supplied, are maintained in an analogous manner.

5.6 LOGISTICS SUPPORT

COMSAT International, through its east coast spares depot facility, plans to maintain an inventory of spare stock at the station and at the depot adequate to meet service needs. COMSAT International has developed excellent working

relationships with its equipment vendors and is constantly striving to improve the turn around time required for repair of failed equipment.

5.7 UNATTENDED OPERATION

5.7.1 EQUIPMENT MAINTENANCE

The redundant design of the equipment shortens the actual service impairment to a matter of seconds, which is independent of the time required for the maintenance technician to get to the fault location.

If the failure is isolated to a common system, the spares are generally not immediately available. The redundant design of the equipment protects the service until the replacement part has arrived. Delivery time for spares is generally 24 to 48 hours. After the spares have arrived, a second service call would be required to restore the station.

5.7.2 COMMUNICATIONS MAINTENANCE

For the first year of operation, circuit maintenance will be performed by a dedicated staff at the Quantico facility. A technician will be dispatched from the maintenance center periodically, on a nominal day-shift basis, to perform preventative maintenance routines and conduct operational checks. The maintenance office in Washington, D.C. will also be responsible for other COMSAT International facilities in the

Washington, D.C. metropolitan area. Maintenance center personnel will be on-call 24 hours per day to provide quick response during periods of unattended operation. During unattended operation, COMSAT International monitors the station equipment status signals through a remote link at the ITMC. The equipment status signals provide summary fault information and switching status signals on redundant equipment. The ITMC can manually switch redundant equipment, update antenna tracking or shut down the uplink carrier*, if that carrier is interfering with other satellite services.

*COMSAT International will notify FBIS prior to uplink carrier shutdown. The station monitor and control system design will prevent unauthorized persons from initiating a shutdown sequence.

6. SYSTEM TESTING

6.1 GENERAL

COMSAT International will develop a test plan and submit it at the third design review. The scope of the testing will demonstrate that the earth station meets or exceeds all specified characteristics and that the terrestrial link contributes negligible degradation to the overall system signal quality.

6.2 TEST PLAN

The test plan will define the specific tests to be performed in each category and on specific equipment items and subsystems. The plan will include:

a. Terrestrial link testing
b. Earth station to satellite loop testing
c. Earth station to earth station system testing
d. End-to-end system testing from the demarcation point at FBIS headquarters to a corresponding point overseas

6.3 TEST PROCEDURES

COMSAT International will also provide detailed test procedures based on the test plan described above. The test procedures will include:

a. A description of the test method
b. Detailed block diagram of the test setup
c. List of test equipment to be used
d. Test levels and settings of all test equipment
e. Test data to be taken
f. Performance value to be demonstrated
g. Data sheets for the recording of test data
h. Methods of data reduction to determine the parameter to be demonstrated.

6.4 EQUIPMENT CONFIGURATION FOR TESTING

Testing will be performed on the equipment in an operational configuration using the actual cable connectors, waveguide and hardware.

6.5 NOTIFICATION

FBIS is invited to witness all system testing and will be given advance notice.

7. OPTION

7.1 GENERAL

The basic system consists of a completely nonredundant system (except for the modulators) which operates completely from commercial power and is designed to meet the minimal requirements of BG-28-74E (Rev. 1). It provides the capability of transmitting and receiving the TV, SCPC and orderwire signals described within the RFP. It is also easily expandable to the capacity specified in the RFP. It is also easily expandable to the capacity specified in he RFP and has been designed to meet the 99 percent availability requirement. The following sections describe the option that COMSAT International is proposing to further increase the operational reliability to the overall system.

7.1.1 EQUIPMENT REDUNDANCY

COMSAT International proposes that the system be designed as a fully redundant system. Under the basic system, only the uplink modulators are redundant. The transmit and receive block diagrams, Figures 2-3 and 2-4, show the optional areas that must be included in order to make the system fully redundant. A list of the additional equipment requirements is provided in Secion 7.1.4. The advantages of having a fully redundant transmit and receive system are addressed in Section 5, "Operation and Maintenance." The primary main

advantage is a significant increase in the operational availability of the system. Automatic fault sensing and switchover are provided in those areas containing redundant equipment. When a fault is detected in an on-line unit, the standby unit will be automatically switched to on-line. A manual switching capability, both remote and local, will also be provided.

7.1.2 MONITOR AND CONTROL SUBSYSTEM

A centralized monitor and control subsystem is proposed to remote monitor and control both the terrestrial microwave and earth station equipment. The status of each major equipment subsystem for the microwave terminal and repeaters will be continuously monitored by the master monitor and control terminal. Remote equipment will be installed at the microwave terminal, repeater sites and earth station to concentrate all the appropriate information for interface with the master terminal. Service channels available in the microwave terminal and repeaters will be used to interconnect between the remote terminals and the earth station. Equipment status from the terrestrial microwave links, together with the equipment status form the earth station, will be provided to the master terminal located in the COMSAT International Technical Maintenance Center (ITMC) via telephone lines. The details of the monitor and control equipment subsystem is provided Section 3.10.

7.1.2.1 Local and Remote System Description

A microprocessor based system, with several types of input/output capabilities, is used to concentrate or centralize all the appropriate information at the various earth station communication subsystems and transfer this data to a remote ITMC facility. The equipment used for this has been successfully implemented at several COMSAT-operated earth stations for control and monitor of very complex broadband switching systems. A list of some typical control/monitor areas that would be implemented are provided in Table 7-1. This list can be easily expanded to cover additional equipment and/or additional monitor/control areas as the need arises.

The remote equipment, located at COMSAT International's ITMC in New York, also includes a microprocessor based computing system with a video display monitor as the operator interface. A 120- character per second, 80 column printer is used to record all changes occurring at the earth station including status/alarm messages and command messages. The printer can also be used for an operator adjustable, periodic dump of system status.

Table 7-1. Typical Monitor/Control Areas

Equipment		Status/Level	Alarm	Control
LNA	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
Down-Converter	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
HPA	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
	Beam On/Off	x		x
	e.i.r.p.	x		x
Up-converter	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
Modulators	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
Demodulators	Alarm		x	
	On-Line	x		x
	Off-Line	x		x
Terrestrial Link	CXR 1		x	
	CXR 2		x	
Security				
Door Open			x	
Smoke			x	
High Temp			x	

7.1.3 FACILITIES OPTION

7.1.3.1 Site Preparation Enhancements

The site plan under the facilities option consists of extending the basic proposal to include the following additional items which though not called for in the specification seem desirable to have implemented during the initial construction. These include:

a. Removal of all poles within the fenced grounds.
b. Remotely actuated sliding vehicular entrance gate.
c. Video camera based security system.
d. Enlarged developed site totalling 22,500 square feet.
e. Parking provisions for six automobiles.
f. Clearing of overgrowth from access road (240 yards long) outside the perimeter fence.
g. Disposal of poles and felled trees.

The remotely actuated gate and video monitoring system will allow the receptionist to observe and control all traffic entering and leaving the site using one of three low light video cameras located near the site entrance, and gate controls located at the receptionist workstation. An intercom will allow interrogation of anyone desiring access to the site. The two other video cameras and monitors will allow 24-hour monitoring of the site grounds. The cameras will scan the site automatically while also permitting remote manual directional

control. The security provisions also include high pressure sodium flood lights to illuminate the gate, parking area, antenna, and building.

The requirements for removal of trees felled to clear the operational arc of the antenna, the existing transmitter poles and the cleared overgrowth from the access road are not stated. Under the option, COMSAT International will haul these materials to an accessible point to be agreed upon within 1000 feet of the entrance gate.

7.1.3.2 Building Enhancements

The Facilities Option includes several building enhancements over and above the basic proposal including the following:

a. Provision of a battery room for the UPS battery.
b. Location of the UPS within the utility room.
c. Provision of a microwave oven, hot plate and refrigerator for the kitchen.
d. Interior drywall over the CMU walls in the office, reception area and kitchen.
e. Electronic equipment room enlarged by 200 square feet by extending the building end wall 5 feet.
f. Computer floor in the equipment room.
g. Automatic halon system in electronic equipment room.

The battery room will have a concrete floor sealed and finished with an acid resistant paint. The floor will be enclosed to contain a battery spill. A ventilation fan, hydrogen detector and alarm and explosion-proof switches are included. The UPS will be located in the utility room to minimize the acoustic noise level in the occupied areas.

The floor slab in the equipment room will be depressed 18 inches and a computer floor will be installed flush with the floors in the other areas. Delivery of conditioned air to this area will be via the sub-floor space allowing more flexible control of air delivery as equipment is added and heat loads change. Control will be exercised by placement of floor registers as required to deliver air from the sub-floor plenum.

Fire protection will be enhanced by an automatic Halon 1301 system in the electronics equipment area. The alarms in all other rooms will be tied into the central alarm panel.

The building will be enlarged to 40 by 57 feet to accommodate additional terminal equipment and have several enhancements as regards to interior appearance and comfort.

7.1.3.3 Equipment Enhancements

Several enhancements to the operating equipment are included under the Facilities Option. These include:

a. Deicing of the lower half of the antenna reflector.
b. A 200 kW back-up generator.
c. A 60 kW uninterruptible power supply (UPS).

7.1.3.4 Deice System

The antenna will be provided with an automatic deice system consisting of heaters on the lower half of the main reflector, subreflector and feed, and a controller with sensors to detect the presence of coincident moisture and cold conditions. Figures 7-1a, 7-1b, and 7-1c detail the antenna main reflector configuration when operating at 22 degrees elevation. In the plan view, Figure 7-1a, it can be seen that most of the upper half of the reflector is overhung helping to keep it clear of snow. The slope of the upper reflector surfaces can be appreciated in Figures 7-1b and 7-1c. The latter figure shows that with half reflector deicing, 50 percent of the surface, located in the lower half of the reflector, will be actively deiced. In addition, 42 percent of the surface, located in the upper half of the reflector, will have an inclination with respect to horizontal of 75 degrees or more minimizing the accumulation of snow. Full reflector deicing is not warranted at low elevation look angles.

7.1.3.5 Back-up Power

The station electric power system for the 15-meter antenna option will consist of two systems: a technical power system and a utility power system. (See attached one-line diagram in Figure 7-2.) The technical power system will receive its supply from the output of a 60 kW 208 V, 3 PH, 4 W static uninterruptible power supply (UPS) and will supply that

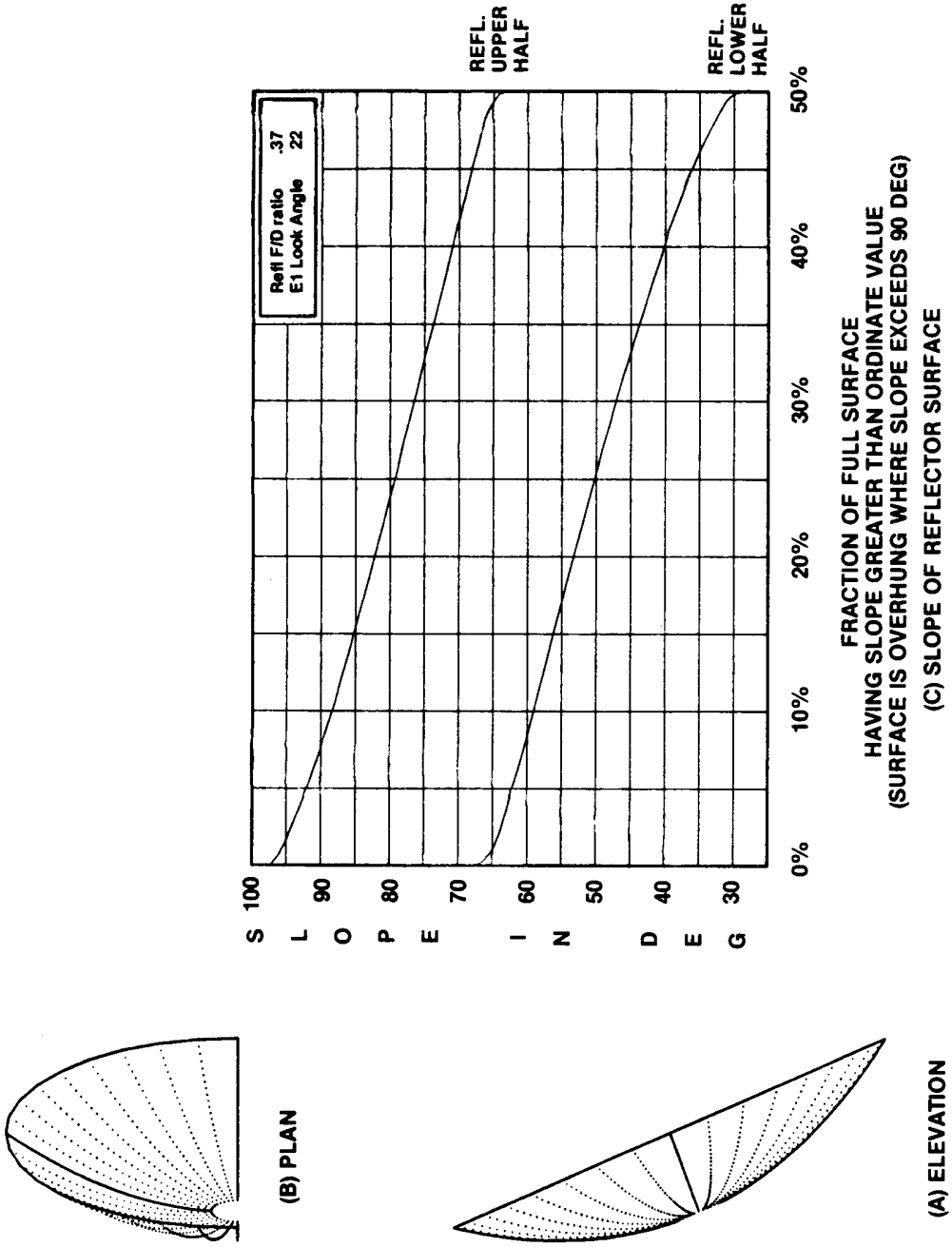

Figure 7-1. Reflector Views and Slope of Reflector Surface

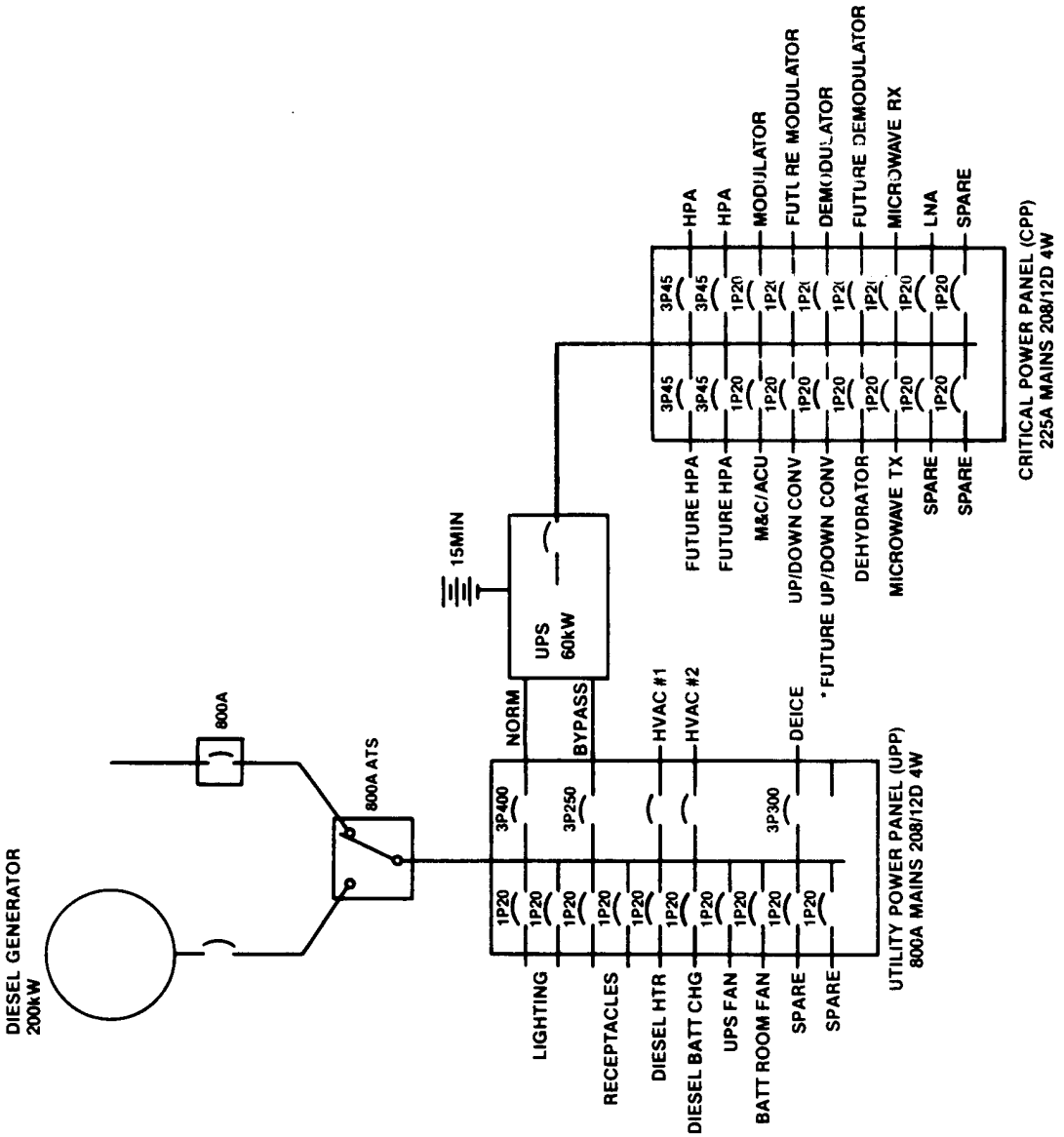

Figure 7-2. FBIS Facility, One-Line Diagram

communications equipment necessary for maintaining continuous satellite communications traffic. The UPS will obtain its supply from the utility power system which will also supply all other station loads. The utility power system will normally receive its supply from a 208 V, 3 PH, 4 W utility company service lateral, which will be backed up by a 200 kW standby diesel generator set through a 800A transfer switch. Utility system demand will be 175 kVA.

Power will be distributed to the loads via two circuit-breaker panelboards: a utility power panel (UPP) and a critical power panel (CPP). The critical power panel receives its supply from the output of the UPS and distributes power to technical loads. The utility power panel receives its supply from the auto transfer switch which can connect the panel to either the generator or the utility service and distributes power to the UPS input and all other utility loads.

Upon the loss of the utility company feeder, the UPS will maintain continuous power supply to the technical loads from storage batteries. The batteries will be capable of supplying the load for 15 minutes at 100 percent load. Upon sensing the loss of the utility voltage, the diesel generator will automatically start and assume the full station load through the automatic transfer switch. The loads will be automatically retransferred back to the utility in open transition upon restoration of utility voltage.

All wiring and installation will be accomplished in accordance with the 1984 edition of the National Electrical Code and accepted industry practice. All materials and equipment will conform to applicable industry standards such as ANSI, NEMA, and IEEE and will be UL-listed when listing is

applicable. Light fixtures will be fluorescent, and all wiring devices will be specification grade. Conductors will be THHN copper in EMT or rigid conduit indoors, PVC conduit outside.

Conductors feeding equipment racks and HPA's will be run in metal wireway with hinged covers to facilitate access and expansion. Utility and technical power conductors will be run in separate raceways and panelboards throughout.

7.1.4 OPTIONAL COMMUNICATIONS EQUIPMENT LIST

7.1.4.1 Earth Station

		Quantity
a.	Redundant LNA w/Auto Switch	1
b.	Redundant HPA w/Auto Switch	1
c.	Redundant Up-Converter w/Auto Switch	2
d.	Redundant Down-Converter w/Auto Switch	2
e.	Redundant Demodulators w/Auto Switch	
	15 kHz	6
	8 kHz	1
	60 kHz	1
	TV	1
f.	Additional Modulators 15kHz	5
g.	1:1 Switch for Modulators	9
h.	Video/Audio Switch	1
i.	Harmonic Filter	

7.1.4.2 Terrestrial Microwave Link

	Quantity
Replace microwave transceiver unit with H/S (Hot standby) 2-CH transceiver unit at Rosslyn, Quantico and the repearter sites.	4

7.1.4.3 Monitor and Control System

Local monitor and control system with auto dial feature for remote telephone company interface	1 set

8. PROJECT MANAGEMENT AND ADMINISTRATION

8.1 PROJECT MANAGEMENT

The overall responsibility for the FBIS INTERNET project will be vested in COMSAT International Communications, Inc.

COMSAT has been providing worldwide satellite services for nearly 20 years, and has engineered and managed a large number of international and domestic satellite communications programs. The engineering and program management skill at COMSAT International is concentrated in the Engineering Division, headed by Mr. J. E. Kolsrud, Vice President. The organization chart of the Engineering Division is given in Figure 8-1.

8.1.1 TECHNICAL AND FINANCIAL MANAGEMENT

The technical and financial management of the FBIS INTERNET project will be provided by the Capital Programs Department, Engineering Division, under the direction of Mr. Helmo Raag, who will be the Project Manager for the FBIS INTERNET project.

The Capital Programs Department evaluates the technical and operational needs, takes appropriate action and assembles the required resources for the successful implementation of the service. Principal engineering support

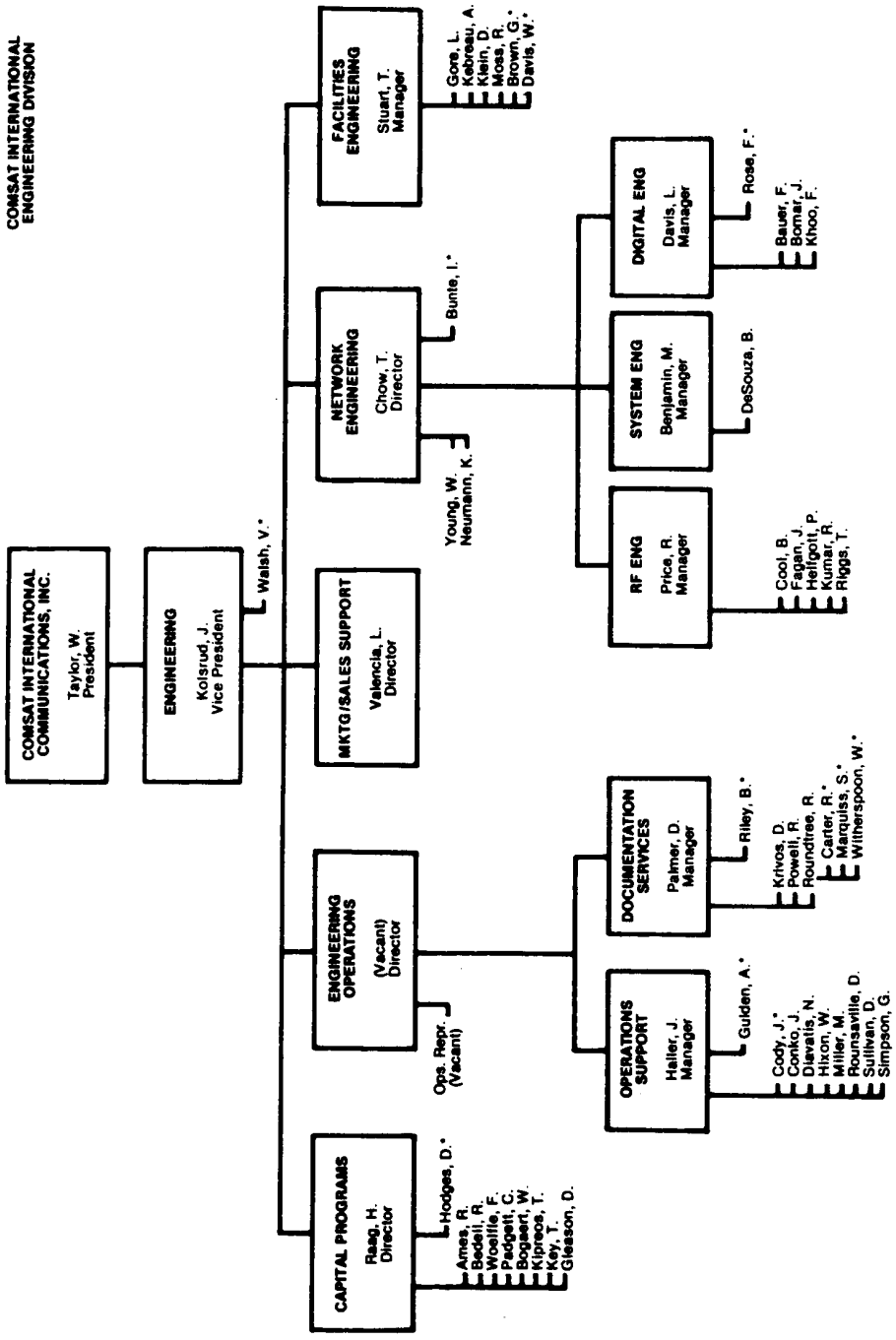

Figure 8-1. Engineering Division Organization Chart

will be provided by the Network Engineering and Facilities Engineering Departments, headed by Messers. Thomas Chow, Director, and Thomas M. Stuart, Manager, respectively.

Through its extensive association over the years with many U.S. government agencies and domestic and international telecommunications authorities, COMSAT has an indepth background for the planning, implementation and management of satellite communications programs. The Project Manager and the Capital Programs Department will draw on this experience and background in the implementation and management of the FBIS INTERNET project. The importance of continuous and efficient communications between the Project Manager and FBIS is recognized. The Project Manager will establish close working relations with the designated FBIS personnel, as well as with the corresponding personnel of the United Kingdom and Panama telecommunications authorities.

Management techniques utilized by COMSAT International will ensure that continuous and direct communications are maintained between the Project Manager and his support staff. Formal and informal status reviews will be conducted by the Project Manager to communicate objectives and to review progress. COMSAT has found that effective schedule control depends upon early and accurate identification of the major technical performance problems and on a complete analysis of the most critical schedule paths; for this reason, early technical reviews are held. The proposed project schedule is shown in Figure 8-2.

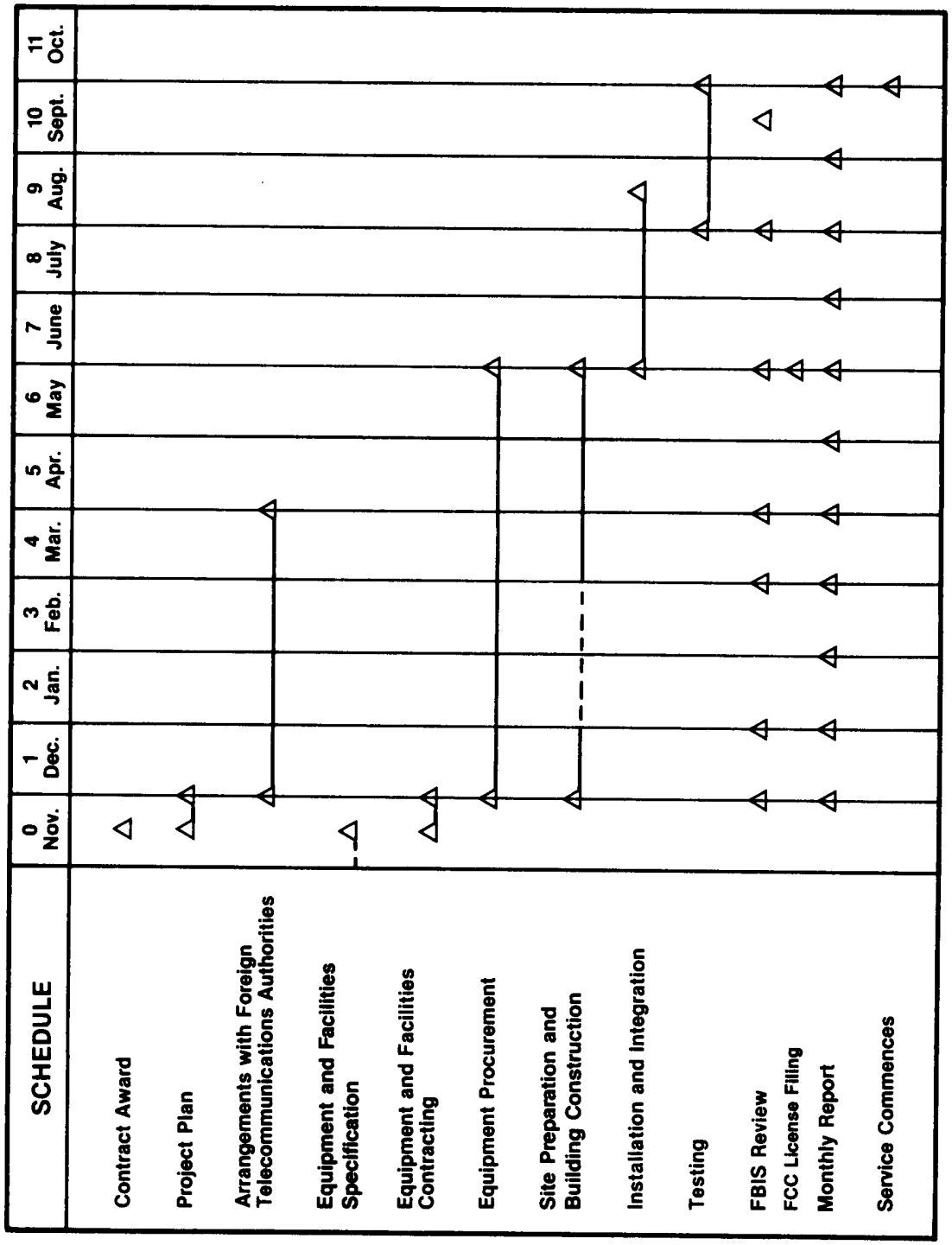

Figure 8-2. Project Schedule

The Project Manager will conduct also periodic project reviews with COMSAT International management to maintain high visibility of the project within the COMSAT International management structure and to provide continual management guidance and direction to the project.

8.2 PROJECT PLANNING AND IMPLEMENTATION

The Project Manager will develop and maintain a project plan. The plan will be submitted for FBIS approval and will detail how the required resources are allocated, the schedule is controlled, and the performance can be measured.

The project plan will contain the following:

a. The major tasks and equipment involved.
b. The project schedule with detailed milestones and delivery dates indicated.
c. A listing of the major activities within the project.
d. The assignment of key personnel to the project.
e. Manpower allocation and training of personnel.
f. Definition of responsibilities and authorities assigned to the Project Manager and his project team.
h. Definition and scheduling of steps with overseas telecommunications authorities for all required action.

8.3 MANAGEMENT REPORTS

COMSAT International will prepare and submit to FBIS five copies of a summary project status report on a monthly basis commencing 15 days after effective date of contract award. These reports will include:

a. Project overview emphasizing project status.
b. Significant progress-development for the reporting period. This portion will emphasize any changes which have occurred during the reporting period.
c. Problem area discussion to identify potential problems early to enable work-arounds, solutions, etc.
d. Planned progress vs. actual progress, including deviations from schedule to identify where actual progress is ahead of or behind schedule.

8.4 KEY PERSONNEL

The following individuals are authorized to conduct negotiations or to discuss details relating to this service:

1. David E. Gourley, Vice President, Marketing and Sales
2. James T. McKenna, Director, Government Sales
3. Joseph F. Donnelly, Director of Contracts

8.5 PROJECT SCHEDULE

A listing of the proposed schedule shown in Figure 8-2 is provided as follows:

	Starts	Duration
Contract Award	15 Nov. 85	
Project Plan	15 Nov. 85	10 days
Equipment and Facilities Specifications*	14 Oct. 85	
Filing for FCC Construction Permit	22 Nov. 85	
FBIS Review	2 Dec. 85	
Arrangements with Foreign Telecommunications Authorities	2 Dec 85	4 months
Equipment and Facilities Contracting	18 Nov. 85	2 weeks
Equipment Procurement	2 Dec. 85	6 months
Site Development and Building Construction	2 Dec. 85	6 months
FBIS Review	15 Jan. 86	

*To expedite the overall project schedule, COMSAT International assumes the risk and will generate the equipment and facilities specifications in advance of the estimated contract award date.

	Starts	Duration
Installation and Integration	1 June 86	2.5 months
FBIS Review	1 June 86	
Filing of the Tariffs and for FCC Authorization to operate the earth terminal	1 June 86	
FBIS Review	1 Aug. 86	
Testing	1 Aug. 86	2 months
FBIS Review	15 Sept. 86	
Service Commences	1 Oct. 86	

8.6 COMPLIANCE REVIEW

The COMSAT International proposal for FBIS CONUS Earth Terminal, RFP-16-85, dated 10 September 1985 complies in all respects with the Statement of Work of the RFP.

8.7 LICENSING

Upon award of contract by FBIS, COMSAT International will apply for appropriate permits and licenses for construction and operation of the earth station and microwave links.

Next 16 Page(s) In Document Denied

9. COMSAT INTERNATIONAL COMMUNICATIONS, INC., AND COMSAT CORPORATE CAPABILITIES

9.1 COMSAT INTERNATIONAL COMMUNICATIONS, INC.

COMSAT International Communications, Inc. is a new, international telecommunications service carrier organized to provide customers with a unique approach to their communications needs and services. COMSAT International offers end-to-end international communications connections--from point-to-origin to point-of-destination.

The Digital Express services provide the most efficient international communications transmissions available today. COMSAT International's expanded services now allow customers to transmit multiplexed voice and data at bit rates of 2.048Mbps and higher. International telephone, data, and video transmissions can be relayed via this state-of-the-art, all-digital service.

For organizations that need to communicate with overseas locations, COMSAT International provides point-to-point or point-to-multipoint dedicated networks. Communications services are tailored to meet specific customer requirements for all communications services--the transmission of broadcast, video, voice, data and facsimile.

COMSAT International offers its customers the capability to integrate their communications needs into customized digital networks, resulting in reduced costs.

COMSAT International maintains close working relationships with several overseas administrations in providing these services. In addition, COMSAT International has a full-time staff located in Europe (London, U.K.) to ensure effective liaison and service fulfillment.

Beginning with a new international earth station and control facilities in New York, COMSAT International is implementing a nationwide network of international earth station gateways in major cities across the United States. A number of dedicated, customer-premise facilities are also planned based on individual customer needs.

9.2 CORPORATE CAPABILITIES

The Communications Satellite Corporation (COMSAT) provides communications services and products to the international, maritime, and U.S.A. domestic markets. Supported by a highly skilled and experienced workforce, a fine reputation and financial strength, the Corporation is presently a leader in providing:

- International communications carrier services, including private networks, to serve the needs of business, government, and other organizations

- Satellite-based space communications services, provided through the INTELSAT and INMARSAT satellite systems
- Equipment for the commercial and defense telecommunications industries
- Technical and communications engineering consulting services for business and governments

These lines of business are managed through three major operating divisions.

9.3 COMMUNICATIONS SERVICE DIVISION

9.3.1 COMSAT INTERNATIONAL COMMUNICATIONS, INC.

This fully-owned COMSAT subsidiary provides international communications carrier services and conducts COMSAT's competitive business in earth stations for international transmissions (see discussion in Section 9.1).

9.3.2 COMSAT GENERAL CORPORATION

Through COMSAT General Corporation, COMSAT provides satellite-based communications systems and services for a broad range of needs. One such system distributes NBC-TV network programming to NBC affiliate stations across the nation. Another, for Holiday Inns, Inc., will distribute in-room video

entertainment to Holiday Inn Hotels nationwide. COMSAT General leases the capacity of its COMSTAR satellite system to AT&T for domestic communications and furnished capacity to the U.S. Navy and INMARSAT through the three-satellite, global MARISAT system.

9.4 SPACE COMMUNICATIONS DIVISION

9.4.1 INTELSAT SATELLITE SERVICES

This business division manages COMSAT's provision of international communications services to primarily U.S. carriers through the space segment of the International Telecommunications Satellite Organization (INTELSAT), as well as manages COMSAT's participation in INTELSAT, of which it owns 22.5 percent.

9.4.2 MARITIME SERVICES

Maritime Services is an on-going regulated business that is responsible for the full range of communications services that COMSAT provides through the International Maritime Satellite Organization (INMARSAT), and for COMSAT's participation in INMARSAT, of which it owns 31 percent.

9.4.3 COMSAT LABORATORIES

COMSAT Laboratories is the research and development center of the Corporation and its subsidiaries. An acknowledged leader and pioneer in its field, COMSAT Laboratories has been on the cutting edge of satellite communications technology for many years and has made significant contributions to advancing the field. The Laboratories develops and establishes the feasibility of new earth station and spacecraft devices and components; investigates satellite network architectures and terrestrial interface issues; performs system transmission analyses and propagation experiments; and develops system planning and analysis software, reliability models, and standards.

A major role of COMSAT Laboratories is to conduct research, development, and engineering support activities to provide a strong, technological base in support of the Corporation's current and future business activities, and further, to stimulate and enhance the Corporation's efforts to bring the benefits of satellite telecommunications to a broad spectrum of users. About two-thirds of the work is "customer-directed", sensitive to specific initiatives, problems, or projects as defined by customers. The remaining one-third is long range research and development designed to bring the scientific and engineering skills at the Laboratories to bear on exploration and advancement of satellite telecommunications. This R&D program is goal-oriented basic or fundamental research.

9.4.4 COMSAT TECHNICAL SERVICES

COMSAT Technical Services provides technical and consulting services previously available from INTELSAT Technical Services in the former COMSAT World Systems Division and from Systems Technology Services in COMSAT General Corporation; the technical services to earth station networks provided through the COMSAT Maintenance & Supply Center (M&S Center); and software and computer-aided design products and services offered by Compact Software, Inc. of Palo Alto, California.

The COMSAT M&S Center provides technical support services for earth stations, including maintenance and training.

The M&S Center maintains an extensive, computerized inventory of earth station and microwave modules, parts, and generic supplies from many manufacturers. Many users rely on its comprehensive logistic system for routine and urgent requirements, because it is on call 24 hours a day to respond to emergency requests. In addition, M&S provides repair, overhaul, and calibration services at a customer's site or in COMSAT facilities. It offers a full line of telecommunications training, ranging from programs in advanced technologies to basic satellite communications courses. These systems-oriented training programs accommodate students with a wide range of prior technical knowledge, and include hands-on equipment training, audiovisual presentations, and practical exercises.

9.5 COMSAT TECHNOLOGY PRODUCTS

COMSAT Technology Products, develops, manufactures and markets a wide range of telecommunications products through its subsidiaries: Amplica, TeleSystems and its newly created Network Products Division. These products are aimed at a diversity of markets and include:

- microwave amplifiers and systems for the defense industry
- mobile satellite terminals for oil and marine markets
- transmission, voice control and enhancement equipment for carriers
- two-way digital data terminals for customers interested in private networks
- television receive-only terminals for the homeowner.

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10. REPRESENTATIONS, CERTIFICATIONS, AND OTHER STATEMENTS OF OFFEROR

10.1 CERTIFICATION

COMSAT International hereby certifies that it is not required under the terms of this RFP to deliver to FBIS technical data which is deliverable under any other government contracts.

10.2 FORMS

The full text of provisions, prepared for this proposal, are included in the pages that follow.

PART IV, SECTION K

REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFEROR

The full text provisions set forth herein are applicable to this solicitation if checked. The offeror represents and certifies that:

(X) 1. FAR 52.203-2, Certificate of Independent Price Determination (APR 1984)

(a) The offeror certifies that—

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to

(i) those prices,

(ii) the intention to submit an offer, or

(iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a formally advertised solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory—

(1) Is the person in the offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a) (1) through (a)(3) above; or

(2) (i) Has been authorized, in writing to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above David E. Gourley, VP Marketing & Sales

(insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization);

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the offeror deletes or modifies subparagraph (a)(2) above, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(X) 2. FAR 52.203-4 Contingent Fee Representation and Agreement (APR 1984)

(a) *Representation.* The offeror represents that, except for full-time bona fide employees working solely for the offeror, the offeror—(Note: The offeror must check the appropriate boxes. For interpretation of the representation, including the term "bona fide employee", see Subpart 3.4 of the Federal Acquisition Regulation.)

(1) ( ) has, (X) has not employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(2) ( ) has, (X) has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(b) *Agreement.* The offeror agrees to provide information relating to the above Representation as requested by the Contracting Officer and, when subparagraph (a) (1) or (a)(2) is answered affirmatively, to promptly submit to the Contracting Officer—

(1) A completed Standard 119, Statement of Contingent or Other Fees, (SF 119); or

(2) A signed statement indicating that the SF 119 was previously submitted to the same contracting office, including the date and applicable solicitation of contract number, and representing that the prior SF 119 applies to this offer.

( ) 3. FAR 52.208-2 Jewel Bearings and Related Items Certificate (APR 1984)

(a) This is to certify that—

(1) Jewel bearings and/or related items, as defined in the Required Sources for Jewel Bearings and Related Items clause, will be incorporated into one or more items/will not be incorporated into any item (delete one) covered by this offer;

(2) Any jewel bearings required (or an equal quantity of the same type, size, and tolerances) will be ordered from the William Langer Plant, Rolla, North Dakota 58367, as provided in the Required Sources for Jewel Bearings and Related Items clause; and

(3) Any related items required (or an equal quantity of the same type, size, and tolerances) will be acquired from domestic manufacturers, including th Plant, if the items can be obtained from those sources.

(b) Attached to this certificate are estimates of the quantity, type, and size (including tolerances) of the jewel bearings and related items required, and identification of the components, subassemblies, or parts that require jewel bearings or related items.

Date of Execution _____
Solicitation No. _____
Name _____
Title _____
Firm _____
Address _____

( ) 4. FAR 52.209-1 Qualified Products—End Items (APR 1984)

(a) The Contracting Officer will make awards for end items requiring qualification only if the items are qualified for inclusion in the Qualified Products List (QPL) identified below. The item must be qualified at the time set for opening of bids, or the time of award of negotiated contracts, whether or not the item is actually included in the QPL. Offerors should contract the specification preparing activity (SPA) designated below to arrange for qualification of the products they intend to offer.

QPL _____
SPA (Name) _____
(Address) _____

(b) Offerors shall insert the item name and the test number (if known) of each qualified product in the blank spaces below.

Item Name _____
Test Number _____

(c) Offerors of products that have been qualified, but not yet listed, shall submit evidence of qualification with their offers, in order to receive consideration. If this is a formally advertised acquisition and the qualified product offered is not identified, either above or elsewhere in the bid, the Contracting Officer will reject the bid.

(d) Any change in location or ownership of the plant where a previously qualified product was manufactured requires reevaluation of the qualification. The reevaluation must be accomplished before the bid opening date for advertised acquisitions and before the date of award for negotiated acquisitions. Failure of offerors to arrange for timely reevaluation shall preclude consideration of their offers.

(X) 5. FAR 52.215-6 Type of Business Organization (APR 1984)

The offeror by checking the applicable box, represents that it operates as (X) a corporation incorporated under the laws of the State of Delaware ( ) an individual, ( ) a partnership, ( ) a nonprofit organization, or ( ) a joint venture.

(X) 6. FAR 52.215-11 Authorized Negotiators (APR 1984)

The offeror represents that the following persons are authorized to negotiate on its behalf with the Government in connection with this request for proposal: (list names, titles, and telephone number of the authorized negotiators).

D. Gourley - VP Sales (202)863-6235
J. Donnelly - Dir. Contracts (202)863-6718
J. McKenna - Dir. Sales (202)863-6106

(X) 7. FAR 52.215-19 Period of Acceptance of Offer (APR 1984)

In compliance with the solicitation, the offeror agrees, if this offer is accepted with _____ calendar days (60 calendar days unless a different period is inserted by the offeror) from the date specified in the solicitation for receipt of offers, to furnish any or all items on which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the Schedule.

(X) 8. FAR 52.215-20 Place of Performance (APR 1984)

(a) The offeror in the performance of any contract resulting from this solicitation, (X) intends, ( ) does not intend (check applicable block) to use one or more plants or facilities located at a different address from the address of the offeror as indicated in this proposal.

(b) If the offeror checks "intends" in the paragraph (a) above, it shall insert in the spaces provided below the required information:

Place of Performance (Street Address, City County, State, Zip Code)	Name and Address (Owner and Operator of the Plant or Facility if Other than Offeror or Quoter
Washington, D.C. Metropolitan Area	

(X) 9. FAR 52.219-1 Small Business Concern Representation (APR 1984)

The offeror represents and certifies as part of its offer that it ( ) is, (X) is not a small business concern and that ( ) all, (X) not all supplies to be furnished will be manufactured or produced by a small business concern in the United States, its possessions, or Puerto Rico. "Small business concern", as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

(X) 10. FAR 52.219-2 Small Disadvantaged Business Concern Representation (APR 1984)

(a) *Representation.* The offeror represents that it ( ) is, (X) is not a small disadvantaged business concern.

(b) *Definitions.*

"Asian-Indian American", as used in this provision, means a United States citizen whose origins are in India, Pakistan, or Bangladesh.

"Asian-Pacific American", as used in this provision, means a United States citizen whose origins are in Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territory of the Pacific Island, the Northern Mariana Islands, Laos, Cambodia, or Taiwan.

"Native Americans", as used in this provision, means American Indians, Eskimos, Aleuts, and native Hawaiians.

"Small business concern", as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operations in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

"Small disadvantaged business concern", as used in this provision, means a small business concern that (1) is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged, or a publicly owned business having at least 51 percent of its stock owned by one or more socially and economically disadvantaged individuals and (2) has its management and daily business controlled by one or more such individuals.

(c) *Qualified groups.* The offeror shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Asian-Indian Americans, and other individuals found to be qualified by the SBA under 13 CPF 124.1.

(X) 11. FAR 52.219-3 Women-Owned Small Business Representation (APR 1984)

(a) *Representation.* The offeror represents that it ( ) is, (X) is not a women-owned small business concern.

(b) *Definitions.*

"Small business concern", as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominate in the field of operation in which it is bidding on Government contract, and qualified as a small business under the criteria and size standards in 13 CFR 121.

"Women-owned", as used in this provision, means a small business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

(X) 12. FAR 52.222-19, Walsh-Healey Public Contract Act Representation (APR 1984)

The offeror represents as a part of this offer that offeror is (X) or is not ( ) a regular dealer in, or is ( ) or is not ( ) a manufacturer of, the supplies offered.

(X) 13. FAR 52.222-21 Certification of Nonsegregated Facilities (APR 1984)

(a) "Segregated facilities", as used in this provision, means any waiting rooms, work area, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated on the basis of race, color, religion, or national original because of habit, local custom, or otherwise.

(b) By the submission of this offer, the offeror certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The offeror agrees that a breach of this certification is a violation of the Equal Opportunity clause in the contract.

(c) The offeror further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will

(1) Obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause;

(2) Retain the certifications in the files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES:

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually). NOTE: The penalty for making false statement in offers is prescribed in 18 U.S.C. 1001.

(X) 14. FAR 52.222-22 Previous Contracts and Compliance Reports (APR 1984)

The offeror represents that

(a) It (X) has, ( ) has not participated in a previous contract or subcontract subject either to the Equal Opportunity clause of this solicitation, the clause originally contained in Section 310 of Executive

Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114;

(b) It (X) has, ( ) has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(X) 15. FAR 52.222-25 Affirmative Action Compliance (APR 1984)

The offeror represents that (a) it (X) has developed and has on file, ( ) has not developed and does not have on file, at each establishment, affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or (b) it ( ) has not previously had contracts subject to the written affirmative action programs requirements of the rules and regulations of the Secretary of Labor.

(X) 16. FAR 52.223-1 Clean Air and Water Certification (APR 1984)

The offeror certifies that

(a) Any facility to be used in the performance of this proposed contract is ( ), is not (X) listed on the Environmental Protection Agency List of Violating Facilities;

(b) The offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the Environmental Protection Agency, indicating that any facility that the offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

( ) 17. FAR 52.223-4 Recovered Material Certification (APR 1984)

The offeror certifies, by signing this offer, that recovered materials, as defined in section 23.402 of the Federal Acquisition Regulation, will be used as required by the applicable specifications.

(X) 18. FAR 52.225-1 Buy American Certificate (APR 1984)

The offeror certifies that each end product, except those listed below, is a domestic end product (as defined in the clause entitled "Buy American Act—Supplies"), and that components of unknown origin are considered to have been mined, produced, or manufactured outside the United States.

Excluded End Products	Country of Origin
_____	_____
_____	_____
_____	_____

(List as necessary)

Offerors may obtain from the Contracting Officer lists of articles, materials, and supplies excepted from the Buy American Act (listed in section 25.108 of the Federal Acquisition Regulation).

(X) 19. FAR 52.225-6 Balance of Payments Program Certificate (APR 1984)

(a) The offeror hereby certifies that each end product or service, except the end products or services listed below, is a domestic end product or service (as defined in the clause entitled "Balance of Payments Program") and that components of unknown origin have been considered to have been mined, produced, or manufactured outside the United States.

Excluded End Products or Services Line Item No.	Country of Origin
_____	_____
_____	_____
_____	_____

(List as necessary)

(b) Offers will be evaluated by giving a certain preference to domestic end products or services over foreign end products or services. Evaluation will be in accordance with section 25.303(b) of the Federal Acquisition Regulation.

(c) Offers will be evaluated in accordance with Part 25 of the Federal Acquisition Regulation.

( ) 20. FAR 52.227-7 Patents—Notices of Government Licensee (APR 1984)

The Government is obligated to pay a royalty applicable to the proposal acquisition because of a license agreement between the Government and the patent owner. The patent number is _____, and the royalty rate is _____. If the offeror is the owner of or a licensee under, the patent, indicate below:

( ) owner

( ) licensee

If an offeror does not indicate that it is the owner or licensee of the patent, its offer will be evaluated by adding thereto an amount to the royalty.

(X) 21. FAR 52.230-1 Cost Accounting Standards Notices and Certification (National Defense) (APR 1984)

Note: This notice does not apply to small businesses or foreign governments.

This notice is in four parts, identified by Roman Numerals I through IV.

Offerors shall examine each part and provide the requested information in order to determine Cost Accounting Standards (CAS) requirements applicable to any resultant contract.

I. DISCLOSURE STATEMENT—COST ACCOUNTING PRACTICES AND CERTIFICATION

(a) Any contract in excess of $100,000 resulting from this solicitation, except contracts in which the price negotiated is based on (1) established catalog or market prices of commercial items sold in substantial quantities to the general public, or (2) prices set by law or regulation, and except for contracts which may be exempt under the provisions of CFR 331.30(b) will be subject to the requirements of the Cost Accounting Standards Board (CASB).

(b) Any offeror submitting a proposal which, if accepted, will result in a contract subject to the requirements of the CASB must, as a condition of contracting, submit a Disclosure Statement as required by regulations of the Board. The Disclosure Statement must be submitted as a part of the offeror's proposal under this solicitation unless the offeror has already submitted a Disclosure Statement disclosing the practices used in connection with the pricing of this proposal. If an applicable Disclosure Statement has already been submitted, the offeror may satisfy the requirement for submission by providing the information requested in paragraph (c) below.

CAUTION: A practice disclosed in a Disclosure Statement shall not, by virtue of such disclosure, be deemed to be a proper, approved, or agreed-to practice for pricing proposals or accumulating and reporting contract performance cost data.

(c) Check the appropriate box below:

( ) (1) Certificate of Concurrent Submission of Disclosure Statement

The offeror hereby certifies that, as a part of the offer, copies of the Disclosure Statement have been submitted as follows:

(i) Original and one copy to the cognizant Administrative Contracting Officer (ACO), and

(ii) one copy to the cognizant contract auditor.

(Disclosure must be on Form Number CASB-DS-. Forms may be obtained from the cognizant ACO.)

Date of Disclosure Statement:

_____

Name and Address of Cognizant ACO where filed: _____

_____

_____

The offeror further certifies that practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement.

(X) (2) Certificate of Previously Submitted Disclosure Statement

The Offeror hereby certifies that a Disclosure Statement was filed as follows:

Date of Disclosure Statement: July 20, 1983

DCASMA - Baltimore

300 E. Joppa Road

Towson, Maryland 21204

Name and Address of Cognizant ACO where filed:

The offeror further certifies that the practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the applicable disclosure statement.

( ) (3) Certificate of Monetary Exemption

The offeror hereby certifies that the offeror, together with all division, subsidiaries, and affiliates under common control, did not receive net awards of negotiated national defense prime contracts and subcontracts subject to CAS totaling more than $10 million in the cost accounting period immediately preceding the period in which this proposal was submitted. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting officer immediately.

( ) (4) Certificate of Interim Exemption

The offeror hereby certifies that (i) the offeror first exceeded the monetary exemption for disclosure, as defined in (3) above, in the cost accounting period immediately preceding the period in which this offer was submitted and (ii) in accordance with the regulations of the CASB (4 CFR 251.40(f)), the offeror is not yet required to submit a Disclosure Statement. The offeror further certifies that if an award resulting from this proposal has not been made within 90 days after the end of that period, the offeror will immediately submit a revised certificate to the Contracting Officer, in the form specified under (1) or (2) above, as appropriate to verify submission of a completed Disclosure Statement.

CAUTION: Offerors currently required to disclose because they were awarded a CAS-covered national defense prime contract or subcontract of $10 million or more in the current cost accounting period may not claim this exemption (4). Further, the exemption applies only in connection with proposals submitted before expiration of the 90-day period following the cost accounting period in which the monetary exemption was exceeded.

II. COST ACCOUNTING STANDARDS—EXEMPTION FOR CONTRACT OF $500,000 OR LESS

If this proposal is expected to result in the award of a contract of $500,000 or less, the offeror shall indicate whether the exemption below is claimed. Failure to check the box below shall mean that the resultant contract is subject to CAS requirements or that the offeror elects to comply with such requirements.

( ) The offeror hereby claims an exemption from the CAS requirements under the provisions of 4 CFR 331.30(b)(7) and certifies that notification of final acceptance of all deliverable items has been received on all prime contracts or subcontracts containing the Cost Accounting Standards clause or the Disclosure and Consistency of Cost Accounting Practices clause. The offeror further certifies that the Contracting Officer will be immediately notified in writing when an award of any other contract or subcontract containing Cost Accounting Standards clauses is received by the offeror subsequent to this certificate but before the date of any award resulting from this proposal.

III. COST ACCOUNTING STANDARDS—ELIGIBILITY FOR MODIFIED CONTRACT COVERAGE

If the offeror is eligible to use the modified provisions of 4 CFR 332 and elects to do so, the offeror shall indicate by checking the box below. Checking the box below shall mean that the resultant contract is subject to the Disclosure and Consistency of Cost Accounting Practices clause in lieu of the Cost Accounting Standards clause.

( ) The offeror hereby claims an exemption from the Cost Accounting Standards clause under the provisions of 4 CFR 331.30(b)(2) and certifies that the offeror is eligible for use of the Disclosure and Consistency of Cost Accounting Practices clause because (i) during the cost accounting period immediately preceding the period in which this proposal was submitted, the offeror received less than $10 million in awards of CAS-covered national defense prime contracts and subcontracts, and (ii) the sum of such awards equaled less than 10 percent of total sales during that cost accounting period. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting Officer immediately.

CAUTION: An offeror may not claim the above eligibility for modified contract coverage if this proposal is expected to result in the award of a national defense contract of $10 million or more or if, during its current cost accounting period, the offeror has been awarded a single CAS-covered national defense prime contract or subcontract of $10 million or more.

IV. ADDITIONAL COST ACCOUNTING STANDARDS APPLICABLE TO EXISTING CONTRACTS

The offeror shall indicate below whether award of the contemplated contract would, in accordance with paragraph (a)(3) of the Cost Accounting Standards clause, require a change in established cost accounting practices affecting existing contracts and subcontracts.

( ) YES ( ) NO

NOTE: If the offeror has checked "yes" above and is awarded the contemplated contract, the offeror will be required to comply with the requirements of paragraphs (a)(i), (b), and (c) of the Administration of Cost Accounting Standards clause.

(X) 22. FAR 52.230-2 Cost Accounting Standards Notices and Certification (Nondefense) (APR 1984)

(a) Any contract over $100,000 resulting from this solicitation shall be subject to Cost Accounting Standards (CAS) if it is awarded to a business unit that is currently performing a national defense CAS-covered contract or subcontract, except when—

(1) The award is based on adequate price competition;

(2) The price is set by law or regulation;

(3) The price is based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or

(4) One of the exemptions in 4 CFR 331.30(b) applies (also see Federal Acquisition Regulation (FAR) 30.301(b)).

(b) Contracts not exempted from CAS shall be subject to full or modified coverage as follows:

(1) If the business unit receiving the award is currently performing a national defense contract or subcontract subject to full CAS coverage (4 CFR 331), this contract will have full CAS coverage and will contain the clauses from the FAR entitled Cost Accounting Standards (52.230-03) and Administration of Cost Accounting Standards (52.230-04).

(2) If the business unit receiving the award is currently performing a national defense contract or subcontract subject to modified CAS coverage (4 CFR 332), this contract will have modified coverage and will contain the clauses entitled Disclosure and Consistency of Cost Accounting Standards (52.230-5) and Cost Accounting Standards (52.230-4).

A. Certificate of CAS Applicability

(X) The offeror is not performing any CAS-covered national defense contract or subcontract. The offeror further certifies that it will immediately notify the Contracting Officer in writing if it is awarded any national defense CAS-covered contract or subcontract subsequent to the date of this certificate but before the date of the award of a contract resulting from this solicitation. (If this statement applies, no further certification is required.)

( ) The offeror is currently performing a negotiated national defense contract or subcontract that contains the Cost Accounting Standards clause in FAR 52.230-3.

( ) The offeror is currently performing a negotiated national defense contract or subcontract that contains the Disclosure and Consistency of Cost Accounting Practices clause in FAR 52.230-5.

B. Additional Certification—CAS Applicable Offerors

( ) The offeror subject to Cost Accounting Standards further certifies that practices used in estimating costs in pricing this proposal are consistent with the practices disclosed in the Disclosure Statement where it has been submitted pursuant to CAS Board regulations (4 CFR 351).

C. Data Required—CAS Covered Offerors

The offeror certifying that it is currently performing a national defense contract containing either CAS clause (see A above) is required to furnish the name, address (including agency or department component), and telephone number of the cognizant Contracting Officer administering the offeror's CAS-covered contracts.

Name of Contracting Officer: _____

_____

Address: _____

_____

Telephone Number: _____

( ) 23. FAR 52.247-53 Freight Classification Description (APR 1984)

Offerors are requested to indicate below the full Uniform Freight Classification (rail) description, or the National Motor Freight Classification description applicable to the supplies, the same as offeror uses for commercial shipment. This description should include the packing of the commodity (box, crate, bundle, loose, setup, knocked down, compressed, unwrapped, etc.) unusual shipping dimensions, and other conditions affecting traffic descriptions. The Government will use these descriptions as well as other information available to determine the classification description most appropriate and advantageous to the Government. Offeror understands that shipments on any f.o.b. origin contract awarded, as a result of this solicitation, will be made in conformity with the shipping classification description specified by the Government, which may be different from the classification description furnished below.

FOR FREIGHT CLASSIFICATION PURPOSES, OFFEROR DESCRIBES THIS COMMODITY

AS _____

_____

_____

(X) 24. DAR SUPP 52.227-7028 Requirement for Technical Data Certification (APR 1974)

The offeror shall submit with his offer a certification as to whether he has delivered or is obligated to deliver to the Government under any contract or subcontract the same or substantially the same technical data included in his offer, if so, he shall identify one such contract or subcontract under which such technical data was delivered or will be delivered, and the place of such delivery.

(X) 25. 52.204-750 Foreign Ownership Control, or Influence (APR 1984)

Offeror's responding to the Request for Proposal (RFP) or contract (as appropriate) are advised that it is the Government's intent to secure services or equipment from firms which are not under foreign ownership, control, or influence (FOCI) or where any FOCI may, in the opinion of the Government adversely impact on security requirements. Accordingly, all offerors responding to this RFP or initiating performance of a contract are required to submit a DOD Form 441s (Certificate Pertaining to Foreign Interests) with their proposal or prior to contract performance (as appropriate). DOD FORM 441s entries should specify, where necessary, the identity, nature, degree, and impact of any FOCI on their organization or activities. Notwithstanding the limitation on contracting with a offeror under FOCI identified above, the Government reserves the right to contract with such offerors under appropriate arrangements, when it determines that such contracts will be in the best interest of the Government.

(X) 26. 52.204-751 Industrial Contractors Polygraph Program (APR 1984)

Security is a criterion in the evaluation of proposals received in response to this solicitation. The adequacy of the requirements, including participation in the Industrial Polygraph Program, are subcriteria in the evaluation. Participation in the Industrial Polygraph Program is a mandatory requirement. The polygraph coverage under this program is limited to counterintelligence issues. Please indicate your willingness to participate in this Industrial Polygraph Program.

Will Participate X

Will Not Participate _____

(X) 27. 52.204-752 Protection Against Compromising Emanations (APR 1984) (Modified)

The offeror shall certify in his proposal that computer equipment, as specified by the Government, to be provided or used under this contract has been accredited to meet the appropriate security requirements of the National Communications Security Subcommittee on Compromising Emanations (SOCCE) National TEMPEST standards (NACSEM No. 5100a, "Compromising Emanations Laboratory Test Standard, Electromagnetics (U)") or other specified standard and, upon request of the Contracting Officer, shall provide documentation supporting this accreditation.

(OFFERORS NOTE: Part IV, Section K will be incorporated by reference into any resultant contract.)

CERTIFICATE PERTAINING TO FOREIGN INTERESTS

TYPE OR PRINT ALL ANSWERS

Form Approved OMB No. 22-R0193

PENALTY NOTICE

PENALTY – Failure to answer all questions, or any misrepresentation (by omission or concealment, or by misleading, false or partial answers) may serve as a basis for denial of clearance for access to classified Department of Defense information. In addition, Title 18, United States Code 1001, makes it a criminal offense, punishable by a maximum of five (5) years imprisonment, $10,000 fine, or both, knowingly to make a false statement or representation to any Department or Agency of the United States, as to any matter within the jurisdiction of any Department or Agency of the United States. This includes any statement made herein which is knowingly incorrect, incomplete or misleading in any important particular.

PROVISIONS

1. This report is authorized by the Secretary of Defense pursuant to authority granted him by E.O. 10865. While you are not required to respond, your eligibility for a facility security clearance cannot be determined if you do not complete this form. The retention of a facility security clearance is contingent upon your compliance with the requirements of DoD 5220.22-M for submission of a revised form as appropriate.

2. When this report is submitted in confidence and is so marked, applicable exemptions to the Freedom of Information Act will be invoked to withhold it from public disclosure.

3. Complete all questions on this form. Answer each question in either the "Yes" or "No" column. If your answer is "Yes" furnish in full the complete information under "Remarks".

QUESTION	YES	NO
1. Do foreign interests own or have beneficial ownership in 5% or more of your organization's securities?	X	
2. Does your organization own any foreign interest in whole or in part?	X	
3. Do any foreign interests have positions, such as directors, officers, or executive personnel in your organization?		X
4. Does any foreign interest control or influence, or is any foreign interest in a position to control or influence the election, appointment, or tenure of any of your directors, officers, or executive personnel?		X
5. Does your organization have any contracts, agreements, understandings or arrangements with a foreign interest(s)?	X	
6. Is your organization indebted to foreign interests?	X	
7. Does your organization derive any income from Communist countries or income in excess of 10% of gross income from non-Communist foreign interests?	X	
8. Is 5% or more of any class of your organization's securities held in "nominee shares," in "street names" or in some other method which does not disclose the beneficial owner of equitable title?	X	
9. Does your organization have interlocking directors with foreign interests?		X
10. Are there any citizens of foreign countries employed by or who may visit your facility (or facilities) in a capacity which may permit them to have access to classified information (exclude cleared immigrant aliens in answering this question)?		X
11. Does your organization have any foreign involvement not otherwise covered in your answers to the above questions?		X

DD FORM 1 SEP 76 441s EDITION OF 1 MAR 60 IS OBSOLETE

REMARKS (Attach additional sheets, if necessary, for a full detailed statement)

See attached.

CERTIFICATION

I CERTIFY that the entries made by me above are true, complete, and correct to the best of my knowledge and belief and are made in good faith.

WITNESS:

5/1/85
DATE CERTIFIED

STAT

Communications Satellite Corporation
CONTRACTOR

Sr. Director
Contracts and Procurement
TITLE

950 L'Enfant Plaza, S.W.
Washington, D.C. 20024
ADDRESS

NOTE: In case of corporation, witnesses not required but certificate below must be completed. Type or print names under all signatures.

NOTE: Contractor, if a corporation, should cause the following certificate to be executed under its corporate seal, provided that the same officer shall not execute both the agreement and the certificate.

CERTIFICATE

I, [redacted] STAT certify that I am the Assistant Corporate Secretary of the corporation named as Contractor herein; that [redacted] STAT who signed this certificate on behalf of the Contractor, was then Sr. Director, Contracts & Procurement of said corporation; that said certificate was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

[redacted] STAT

5/1/85

(Corporate Seal)

SIGNATURE AND DATE

C. Data Required—CAS Covered Offerors

The offeror certifying that it is currently performing a national defense contract containing either CAS clause (see A above) is required to furnish the name, address (including agency or department component), and telephone number of the cognizant Contracting Officer administering the offeror's CAS-covered contracts.

Name of Contracting Officer: _____

_____

Address: _____

_____

Telephone Number: _____

( ) 23. FAR 52.247-53 Freight Classification Description (APR 1984)

Offerors are requested to indicate below the full Uniform Freight Classification (rail) description, or the National Motor Freight Classification description applicable to the supplies, the same as offeror uses for commercial shipment. This description should include the packing of the commodity (box, crate, bundle, loose, setup, knocked down, compressed, unwrapped, etc.) unusual shipping dimensions, and other conditions affecting traffic descriptions. The Government will use these descriptions as well as other information available to determine the classification description most appropriate and advantageous to the Government. Offeror understands that shipments on any f.o.b. origin contract awarded, as a result of this solicitation, will be made in conformity with the shipping classification description specified by the Government, which may be different from the classification description furnished below.

FOR FREIGHT CLASSIFICATION PURPOSES, OFFEROR DESCRIBES THIS COMMODITY

AS _____

_____

_____

(X) 24. DAR SUPP 52.227-7028 Requirement for Technical Data Certification (APR 1974)

The offeror shall submit with his offer a certification as to whether he has delivered or is obligated to deliver to the Government under any contract or subcontract the same or substantially the same technical data included in his offer, if so, he shall identify one such contract or subcontract under which such technical data was delivered or will be delivered, and the place of such delivery.

(X) 25. 52.204-750 Foreign Ownership Control, or Influence (APR 1984)

Offeror's responding to the Request for Proposal (RFP) or contract (as appropriate) are advised that it is the Government's intent to secure services or equipment from firms which are not under foreign ownership, control, or influence (FOCI) or where any FOCI may, in the opinion of the Government adversely impact on security requirements. Accordingly, all offerors responding to this RFP or initiating performance of a contract are required to submit a DOD Form 441s (Certificate Pertaining to Foreign Interests) with their proposal or prior to contract performance (as appropriate). DOD FORM 441s entries should specify, where necessary, the identity, nature, degree, and impact of any FOCI on their organization or activities. Notwithstanding the limitation on contracting with a offeror under FOCI identified above, the Government reserves the right to contract with such offerors under appropriate arrangements, when it determines that such contracts will be in the best interest of the Government.

(X) 26. 52.204-751 Industrial Contractors Polygraph Program (APR 1984)

Security is a criterion in the evaluation of proposals received in response to this solicitation. The adequacy of the requirements, including participation in the Industrial Polygraph Program, are subcriteria in the evaluation. Participation in the Industrial Polygraph Program is a mandatory requirement. The polygraph coverage under this program is limited to counterintelligence issues. Please indicate your willingness to participate in this Industrial Polygraph Program.

Will Participate X

Will Not Participate _____

(X) 27. 52.204-752 Protection Against Compromising Emanations (APR 1984) (Modified)

The offeror shall certify in his proposal that computer equipment, as specified by the Government, to be provided or used under this contract has been accredited to meet the appropriate security requirements of the National Communications Security Subcommittee on Compromising Emanations (SOCCE) National TEMPEST standards (NACSEM No. 5100a, "Compromising Emanations Laboratory Test Standard, Electromagnetics (U)") or other specified standard and, upon request of the Contracting Officer, shall provide documentation supporting this accreditation.

(OFFERORS NOTE: Part IV, Section K will be incorporated by reference into any resultant contract.)

CERTIFICATE PERTAINING TO FOREIGN INTERESTS

TYPE OR PRINT ALL ANSWERS

Form Approved OMB No. 22-R0193

PENALTY NOTICE

PENALTY – Failure to answer all questions, or any misrepresentation (by omission or concealment, or by misleading, false or partial answers) may serve as a basis for denial of clearance for access to classified Department of Defense information. In addition, Title 18, United States Code 1001, makes it a criminal offense, punishable by a maximum of five (5) years imprisonment, $10,000 fine, or both, knowingly to make a false statement or representation to any Department or Agency of the United States, as to any matter within the jurisdiction of any Department or Agency of the United States. This includes any statement made herein which is knowingly incorrect, incomplete or misleading in any important particular.

PROVISIONS

1. This report is authorized by the Secretary of Defense pursuant to authority granted him by E.O. 10865. While you are not required to respond, your eligibility for a facility security clearance cannot be determined if you do not complete this form. The retention of a facility security clearance is contingent upon your compliance with the requirements of DoD 5220.22-M for submission of a revised form as appropriate.

2. When this report is submitted in confidence and is so marked, applicable exemptions to the Freedom of Information Act will be invoked to withhold it from public disclosure.

3. Complete all questions on this form. Answer each question in either the "Yes" or "No" column. If your answer is "Yes" furnish in full the complete information under "Remarks".

QUESTION	YES	NO
1. Do foreign interests own or have beneficial ownership in 5% or more of your organization's securities?	X	
2. Does your organization own any foreign interest in whole or in part?	X	
3. Do any foreign interests have positions, such as directors, officers, or executive personnel in your organization?		X
4. Does any foreign interest control or influence, or is any foreign interest in a position to control or influence the election, appointment, or tenure of any of your directors, officers, or executive personnel?		X
5. Does your organization have any contracts, agreements, understandings or arrangements with a foreign interest(s)?	X	
6. Is your organization indebted to foreign interests?	X	
7. Does your organization derive any income from Communist countries or income in excess of 10% of gross income from non-Communist foreign interests?	X	
8. Is 5% or more of any class of your organization's securities held in "nominee shares," in "street names" or in some other method which does not disclose the beneficial owner of equitable title?	X	
9. Does your organization have interlocking directors with foreign interests?		X
10. Are there any citizens of foreign countries employed by or who may visit your facility (or facilities) in a capacity which may permit them to have access to classified information (exclude cleared immigrant aliens in answering this question)?		X
11. Does your organization have any foreign involvement not otherwise covered in your answers to the above questions?		X

DD FORM 1 SEP 76 441s EDITION OF 1 MAR 60 IS OBSOLETE

REMARKS (Attach additional sheets, if necessary, for a full detailed statement)

See attached.

CERTIFICATION

I CERTIFY that the entries made by me above are true, complete, and correct to the best of my knowledge and belief and are made in good faith.

WITNESS:

5/1/85
DATE CERTIFIED

STAT

By

Communications Satellite Corporation
CORPORATION

Sr. Director
Contracts and Procurement
TITLE

950 L'Enfant Plaza, S.W.
Washington, D.C. 20024
ADDRESS

NOTE: In case of corporation, witnesses not required but certificate below must be completed. Type or print names under all signatures.

NOTE: Contractor, if a corporation, should cause the following certificate to be executed under its corporate seal, provided that the same officer shall not execute both the agreement and the certificate.

CERTIFICATE

I, STAT certify that I am the Assistant Corporate Secretary of the corporation named as Contractor herein; that STAT who signed this certificate on behalf of the Contractor, was then Sr. Director, Contracts & Procurement of said corporation; that said certificate was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

STAT

(Corporate Seal)

5/1/85
SIGNATURE AND DATE

CONFIDENTIAL: To be Used Only in the Evaluation of COMSAT's Proposal to Provide Service to FBIS

1985 Amendment to
1983 DD Form 441s

Question No. 1

The exact data in Exhibits 1 and 2, in response to Question No. 1, may have changed slightly. A more current breakdown can be provided at a later date, if required.

Question Nos. 2, 5, 6, & 7

INTELSAT now consists of 109 member nations, as of February 1, 1985. COMSAT's interest therein is now 22.5%. The new list of Signatories is substituted as Exhibit 3. As a result of the 1985 adjustment, COMSAT will receive a payment of approximately $9 million from INTELSAT. As of December 31, 1984, total INTELSAT Owners' Equity was approximately $1,514 million and its outstanding contractual commitments totalled approximately $1,025 million.

The revenue COMSAT received from INTELSAT less charges for its use of the space segment totalled $13.8 million for 1984. The Corporation's Total Operating Revenues for 1984 were about $442 million and Net Operating Income was about $51 million.

As of January 31, 1985, INMARSAT had 42 members. A new list of Signatories is substituted as Exhibit 4. INMARSAT's

Council currently consists of 26 members of the 42 signatories. The U.S. share of 30.74% in INMARSAT is the largest, followed by those of the U.K., Norway, Japan and the Soviet Union. As of January 31, 1985, all investment shares will be redetermined annually. In February 1985, the net capital contributions of the Signatories and outstanding capital commitments are subject to a ceiling of $350 million.

INMARSAT also has entered into contracts for: (i) the lease from INTELSAT of maritime communications capacity for up to four satellites for seven year periods, overlapping from January 1983 to December 1992, at a total price of approximately $112 million; and (ii) the lease from the European Space Agency of ten satellite-years of service from two MARECS satellites beginning in February 1982; the MARECS lease payments are made in currencies other than U.S. dollars, and, at current exchange rates, the total lease is valued at approximately $56 million. The first MARECS satellite was launched in December 1981 and since May 1982 has been used to provide services in the Atlantic Ocean region. A second MARECS satellite was lost due to an Ariane launch failure in September 1982. A replacement satellite was launched in the fall of 1984 and became operational in January 1985.

The first INTELSAT V satellite with a maritime communications service (MCS) package was made available for use

by INMARSAT in December 1982, and INMARSAT has been providing commercial service in the Indian Ocean region through that satellite since January 1983. The second INTELSAT V satellite was launched in May 1983 and was made available to INMARSAT as the back-up for MARECS A in the Atlantic Ocean region in the third quarter of 1983. A third satellite with an MCS package was launched in October 1983 and became operational in February 1984 as a back-up in the Indian Ocean region. A fourth satellite with an MCS package should be available to INMARSAT by the end of 1985. Under a contract which began in February 1982, COMSAT is providing network coordination services to INMARSAT in the Atlantic Ocean region for seven years for approximately $5.3 million (excluding options).

COMSAT General has a 37 percent ownership interest in a corporation, INTERCOMSA in Panama, which operates an earth station in the INTELSAT system. The communications equipment and related assets of INTERCOMSA are subject to purchase at their net book value by the Government of Panama in 1989.

Recent Financings

In October 1983, COMSAT International N.V., a wholly owned subsidiary of COMSAT, issued $110 million of 7-3/4% convertible subordinated debentures due 1998 which were unconditionally guaranteed by COMSAT. This offering was made

to non-U.S. persons under the terms of an Indenture dated as of October 15, 1983 among COMSAT International N.V. (as the Issuer), COMSAT (as the Guarantor), and Manufacturers Hanover Trust Company (as the Trustee). The rights of the debenture holders are limited to those defined in the Indenture. Other than in connection with the following conversion rights and subsequent Common Stock ownership rights, no non-U.S. debenture holder has any control over COMSAT as a result of this 1983 debenture issuance.

The 7-3/4% debentures are convertible into COMSAT Common Stock at any time prior to redemption or maturity at a stated per share price. The Indenture specifically limits the stock conversion right in order to ensure that the issuance of COMSAT Common Stock upon conversion would not cause COMSAT to exceed the alien ownership limitation placed upon it by statute, that is, not more than 20 percent of the aggregate number of outstanding Series I shares may be held by non-U.S. persons collectively. If the issuance of Common Stock upon conversion by a debenture holder would cause COMSAT to exceed the maximum alien ownership limitation, COMSAT will decline to issue that Common Stock and, in lieu thereof, will issue Common Stock to any person to whom the debenture holder may sell or transfer the right to receive such Common Stock (so

long as the transferee's holdings would not then exceed the maximum alien ownership limitations). Not more than 5 percent of the aggregate number of outstanding Series I shares may be held by any person, syndicate or affiliated group of persons.

In May 1984, COMSAT International N.V. issued $100 million of 12-1/4% debentures due 1989/1991 which were unconditionally guaranteed by COMSAT. This offering was made to non-U.S. persons under the terms of an Indenture dated as of May 1, 1984 among COMSAT International N.V. (as the Issuer), COMSAT (as the Guarantor), and The Chase Manhattan Bank, N.A. (as the Trustee). The debentures are not convertible into COMSAT Common Stock. The rights of the debenture holders are limited to those defined in the Indenture. The debenture holders have an unconditional right to payment of principal and interest, but have no control over COMSAT as a result of this 1984 debenture issuance.

In February 1985, COMSAT issued $100 million of 11-5/8% debentures due 1995. This offering was made to non-U.S. persons under the terms of an Indenture dated as of February 27, 1985 between COMSAT (as the Issuer) and The Chase Manhattan Bank, N.A. (as the Trustee). The debentures are not convertible into COMSAT Common Stock. The rights of the debenture holders are limited to those defined in the

Indenture. The debenture holders have an unconditional right to payment of principal and interest, but have no control over COMSAT as a result of this 1985 debenture issuance.

Copies of the above indentures can be supplied, if required.

In August 1983, COMSAT (as the Borrower) entered into a line of credit agreement with Credit Suisse First Boston Limited (as the Agent) and a number of foreign banks and financial institutions to "back-up" its U.S. commercial paper issuances. Pursuant to the Loan Agreement, the banks have established a loan facility of $100 million for COMSAT's use in financing its general corporate obligations. COMSAT becomes obligated under the Agreement only to the extent that it actually uses the facility and only to the extent of the amount actually borrowed. COMSAT may cancel the facility at any time with prior notice to the facility Agent. As of May 1, 1985, COMSAT had no outstanding obligations under this back-up line of credit.

In May 1985 COMSAT will substitute a new facility for the August 1983 back-up line of credit facility. This new facility will be established pursuant to a Euro-note Purchase Facility Agreement and various other subsidiary Agreements among COMSAT, Credit Suisse First Boston Limited

(as the Facility Agent), and a number of foreign banks and financial institutions. The new Facility will be in the amount of $150 million, and COMSAT will become obligated under the Facility Agreements to issue promissory notes only to the extent that it actually uses the facility and only to the extent of the amount actually borrowed. COMSAT may cancel the facility at any time with prior notice to the Facility Agent.

Question No. 3

Mr. Harper is no longer a member of COMSAT's Board; Mr. Gantt is no longer with the Corporation. Irving Goldstein, President and Director of COMSAT, and Bruce L. Crockett, Vice President and Chief Financial Officer of COMSAT, serve on the Board of INTERCOMSA. Mr. Goldstein's Statement of Full Disclosure and Board Resolution (substituting for Exhibit 5 and 6) are attached; Mr. Crockett's can be forwarded at a later date.

Question No. 8

Kray and Co., a Midwest depository for stock transfers, holds approximately 1.3 million shares of COMSAT stock. Teacal and Co., a Sacramento, California pension fund for teachers, holds approximately 990,000 shares of COMSAT stock. Exhibits 10 and 11 may have changed slightly; a more current breakdown can be provided, if required.

CONFIDENTIAL: To be Used Only in the Evaluation of
COMSAT's Proposal to Provide Service to FBIS

ATTACHMENT
to
CERTIFICATE PERTAINING TO FOREIGN INTERESTS
DD Form 441S dated January 21, 1983
COMMUNICATIONS SATELLITE CORPORATION

Question 1

The Corporation has issued only one type of security, namely, one class of Common Stock. Shares of Common Stock of the Corporation sold to persons other than authorized communications common carriers are "Series I" shares; shares sold to authorized communications common carriers are "Series II" shares. Series I shares owned or held by persons of the classes described in Section 310(a) and paragraphs (1) through (4) of Section 310(b) of the Communications Act of 1934 are "foreign" shares; all other Series I shares are "domestic" shares. The classes described in the Communications Act of 1934 include aliens, foreign governments, representatives of aliens or foreign governments, and corporations organized under the laws of foreign governments (Alien Persons); corporations of which any officer or director is an alien or of which more than 20% of the capital stock is owned of record by Alien Persons; and a corporation which is directly or indirectly controlled by any other corporation of which any officer, or more than one-fourth of the directors, are aliens or of which more than 25% of the capital stock is owned of record or voted by Alien Persons.

The reports the Corporation receives concerning the ownership of its Common Stock by foreign interests are based

on the definitions described above in order that the Corporation may effect Section 304(d) of the Communications Satellite Act of 1962 which limits the aggregate number of foreign shares to 20% of the number of Series I shares issued and outstanding. Thus, for purposes of responding to Question 1 of DD Form 441s, the percentage stated as being held by foreign interests could include ownership by domestic companies which are as little as 21% owned by Alien Persons, which may or may not constitute ownership or control by foreign interests for purposes of DD Form 441s.

Exhibit 1 is a table showing the total number of "foreign" shares outstanding and the percentage of the total number of shares outstanding which are "foreign shares" as of the last business day of each month from November 1981 to November 1982. Exhibit 2 is a geographical breakdown of shareholders of record of foreign shares as of November 30, 1982.

Questions 2, 5, 6 and 7

Activities Related to the INTELSAT System

The Corporation provides satellite links between U.S. earth stations to other countries, territories and possessions through the facilities of the International Telecommunications Satellite Organization (INTELSAT) system. The INTELSAT system is made up of (i) the "space segment", owned by INTELSAT, which consists of satellites in synchronous

orbit and associated terrestrial tracking, telemetry, control and monitoring facilities and (ii) the "ground segment", consisting of earth stations in various countries owned by entities in the respective countries.

INTELSAT operates under two agreements (the Definitive Agreements) which entered into force on February 12, 1973, replacing the Interim Agreements under which INTELSAT had been established in 1964. As of December 1981 INTELSAT had 106 member countries. Exhibit 3 lists the member countries of INTELSAT and their designated entities for participation as of March 1, 1982. To become a member of INTELSAT, a government accedes to the Agreement among Governments, and it, or its designated public or private telecommunications entity, signs the companion Operating Agreement. The financial and legal responsibilities of each Signatory are analogous to those of a partner. The Corporation was designated by the U.S. Government as the U.S. Signatory to the Operating Agreement.

In general, each Signatory has an investment share in INTELSAT based on its portion of total use of the INTELSAT space segment. That investment share carries with it an obligation to contribute a proportionate share of INTELSAT's capital costs, as well as a right to receive a proportionate share of net revenues after deductions for operating and maintenance costs. The investment share of each Signatory is readjusted as of March 1 of each year to approximate the portion of total use of the space segment by the Signatory

for the previous six months. The Corporation's investment share in INTELSAT after the March 1, 1982 adjustment is 24.1%. A year earlier, it was 23.1%. As a result of the 1982 adjustment, the Corporation made payment to INTELSAT of $9.4 million. At December 31, 1981, total INTELSAT Owners' Equity was approximately $860 million, and its outstanding capital commitments totaled approximately $560 million.

The Corporation's representative on the INTELSAT Board of Governors has voting power approximating its investment share. Pursuant to Section 201 of the Satellite Act, the Corporation's representative on the Board of Governors receives guidance from the U.S. Government with respect to certain matters before the Board of Governors which are of specific governmental interest.

INTELSAT Signatories pay INTELSAT for their use of the INTELSAT space segment. Charges for the use of the space segment are computed to provide a specified pretax cumulative rate of return (currently 14%) on INTELSAT's capital. The Corporation realizes revenue from its INTELSAT ownership, net of use charges paid, to the extent that its investment share in INTELSAT exceeds its portion of total use of the INTELSAT space segment. The revenue which the Corporation received from INTELSAT less charges for its use of the INTELSAT space segment totaled $3 million for 1981. The Corporation's Total Operating Revenues for 1981 were about $334 million and Net Operating Income was about $41.6 million.

The Corporation furnishes INTELSAT technical and operational management services under two technical services contracts. One became effective in January 1979 and extends for six years and the other will become effective in January 1983 and will extend for two years. These contracts are structured as umbrella agreements under which tasks are assigned to COMSAT from time to time within the framework of a general statement of work for each agreement. In addition, COMSAT has contracts with INTELSAT to provide tracking, telemetry, command, and monitoring services at U.S. earth stations through 1984. COMSAT also has a Laboratory Assistance Contract (LAC) with INTELSAT, having an umbrella structure, under which an INTELSAT program of research and development aimed at improvements in satellite technology is conducted on a task basis. Approximately 40% of the work associated with the R&D contracted out by INTELSAT is conducted in-house by COMSAT under the LAC, and the balance of INTELSAT's program is conducted under individual contracts open to international competitive bidding. From time to time, COMSAT may participate as a bidder in such competitions. The Corporation received approximately $25 million as a result of the various contracts it had with INTELSAT during 1981.

The INTELSAT Definitive Agreements referred to above contain provisions which call for the sharing of rights in certain inventions and technical information. Such rights

are related to work which may be, or may have been, performed by INTELSAT, or on behalf of INTELSAT, by the Corporation or others through contracts for research and development or for the procurement of equipment for the space segment of the INTELSAT system. The Corporation, as U.S. member in INTELSAT, shares equally with all other members in such rights.

The Corporation has in the past contracted for such work on behalf of INTELSAT and has acquired in its own name certain rights in related inventions and technical information. Although INTELSAT now enters into such contracts directly, the Corporation continues to have an obligation under contracts to which it was a party on behalf of INTELSAT to facilitate the distribution of rights in such inventions and technical information. Specifically, under the clauses in those contracts, the rights granted to contractors may include either a license or title to such inventions and technical information. In addition, INTELSAT members and their designees may obtain rights to use the information and to practice inventions generated or applied by the contractor in performing such work.

Work funded by INTELSAT and performed by the Corporation under prior arrangements with INTELSAT has resulted in the licensing of rights in technical information and patented inventions to other INTELSAT members and persons within the jurisdictions of their governments. Work to be performed under the Laboratory Assistance Contract,

technical services and other R&D related contracts with INTELSAT may also result in such licensing.

These arrangements for sharing of rights in patented inventions and technical information by participants in the INTELSAT system were entered into with the knowledge and approval of the United States Government. It is recognized that in any of the above circumstances, the Corporation or any other U.S. company involved is obliged to comply fully with applicable U.S. laws and regulations governing foreign dissemination to non-U.S. nationals of U.S.-generated technical information, licensing, or research operations.

To the extent required by U.S. laws and regulations, the Corporation's contracts with INTELSAT or other non-U.S. entities are submitted to appropriate Government agencies for clearance. The Corporation does not furnish INTELSAT or other non-U.S. entities with any materials that would be considered classified under U.S. laws or regulations.

The Corporation also contracts with U. S. and foreign entities for research and development work or for the procurement of equipment, as Manager on behalf of the United States Earth Station Ownership Committee (ESOC), which was established following an Order of the Federal Communications Commission requiring joint ownership of U.S. earth stations operating with the INTELSAT system. The agreement of the earth station owners is one among U.S. domestic corporations which specifies certain arrangements for sharing with contractors rights in inventions and technical information.

The contracts involved, whether with U. S. or non-U. S. companies, may contain provisions that grant to the contractor title to, or a license to use, any inventions or technical information developed by the contractor during the course of work performed under the contract. Again, full compliance with applicable U. S. laws and regulations governing foreign dissemination of U. S. generated technical data is observed.

Activities Related to the INMARSAT System

The International Maritime Satellite Organization (INMARSAT) came into existence on July 16, 1979. Its purpose is to develop and operate the space segment (satellites and associated ground control equipment) of a global communications satellite system to serve maritime commercial and safety needs. At June 1, 1982 INMARSAT had 35 members. Its headquarters is in London, England. Exhibit 4 lists its member countries and their respective investment shares as of June 1, 1982.

INMARSAT operates under two international agreements (the INMARSAT Agreements), consisting of:

(a) the "Convention on the International Maritime Satellite Organization (INMARSAT)" (the Convention), which is signed by the governments of participating nations (Parties); and

(b) the "Operating Agreement on the International Maritime Satellite Organization (INMARSAT)" (the Operating Agreement), which is signed by the government of each member

country or its designated public or private telecommunications entity (Signatory).

Pursuant to a 1978 amendment of the Satellite Act, COMSAT is the designated U.S. Signatory in INMARSAT. On February 1, 1982, COMSAT, through the COMSAT World Systems Division, began providing commercial maritime satellite services, such as telex, telephone, facsimile and data, through a global communications satellite system operated by INMARSAT. COMSAT's role in INMARSAT is comparable to its role in INTELSAT. COMSAT has a financial interest in INMARSAT facilities and shares in the revenues and expenses of INMARSAT. The 1978 amendment of the Satellite Act also provided, among other things, for a system of governmental supervision and regulation in connection with COMSAT's participation in INMARSAT.

INMARSAT's organizational structure consists of an Assembly, made up of representatives of Parties, and a Council, consisting currently of 24 representatives of Signatories. Voting of Council members is weighted on the basis of the investment share represented by each member. Of the present 35 INMARSAT Signatories, the U.S. share of 23.4 percent, held by COMSAT, is the largest, followed by those of the Soviet Union, Great Britain, Norway and Japan. Beginning as of a date determined by the Council between February 1, 1984 and January 31, 1985, all investment shares will be redetermined annually in a manner that will give each Signatory an investment share based on its percentage

of total use of the INMARSAT space segment by all Signatories. Each Signatory makes contributions to the capital requirements of INMARSAT in proportion to its investment share. The net capital contributions of Signatories (net of repayments) and outstanding capital commitments of INMARSAT are subject to a ceiling which was raised to $300 million by the Council in February 1982.

On February 1, 1982, INMARSAT began to provide service in the Atlantic, Pacific and Indian Ocean regions using space segment capacity leased from COMSAT General on behalf of the MARISAT Joint Venture. The commercial capacity of the MARISAT satellite system is used to provide maritime communications services in the Atlantic, Pacific and Indian Ocean regions. Under a joint venture arrangement with three other U.S. international carriers, COMSAT General, a wholly-owned subsidiary of COMSAT, has an 86.29 percent ownership interest in the MARISAT satellites and certain communications and control facilities and serves as system manager for the joint venture.

INMARSAT has entered into agreements for (i) the lease from INTELSAT of maritime communication capacity in four INTELSAT V satellites for seven-year periods at a total price of approximately $126 million; and (ii) the lease from the European Space Agency (ESA) of capacity in two ESA MARECS satellites for five years at a total price of approximately $66 million. INMARSAT has also entered into a

contract under which COMSAT will provide network coordination services for INMARSAT in the Atlantic Ocean region for seven years for approximately $5.5 million. The first MARECS satellite replaced the MARISAT satellite in the Atlantic Ocean region at the end of May 1982 as the operating satellite. The second MARECS was lost as the result of a launch failure in September 1982. Negotiations between ESA and INMARSAT are continuing concerning a replacement. The first INTELSAT satellite with a maritime communications package became operational in January 1983 and replaced the MARISAT satellite in the Indian Ocean region.

Other Activities

In addition to contracts entered into with or on behalf of the communications entities mentioned above, the Corporation also enters into contracts, on its own behalf, with U. S. and foreign governments or contractors for consulting services or research and development. In these cases, however, the Corporation is completely free to negotiate the terms and conditions under which rights in inventions and technical information are determined. Under such terms and conditions, the Corporation may agree to grant to contractors licenses to use, or title in, such inventions and technical information. Furthermore, the Corporation may from time to time license to a non-U. S. entity rights of use in the Corporation's patents and technical information. The Corporation, of course, complies fully with the applicable U. S. laws and regulations in all such instances.

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EXHIBIT 1

DATE	TOTAL NUMBER OF SHARES AUTHORIZED	TOTAL NUMBER OF SHARES OUTSTANDING [1]	TOTAL NUMBER OF FOREIGN SHARES OUTSTANDING	PERCENTAGE OF TOTAL NUMBER OF SHARES OUTSTANDING WHICH ARE FOREIGN
November 30, 1981	10,000,100	8,000,014	486,660	6.1
December 31, 1981	10,000,100	8,000,014	446,527	5.6
January 31, 1982	10,000,100	8,000,014	556,483	7.0
February 26, 1982	10,000,100	8,000,014	586,569	7.3
March 31, 1982	10,000,100	8,000,014	686,553	8.6
April 31, 1982	10,000,100	8,000,014	656,689	8.2
May 31, 1982	25,000,000	8,000,014	673,488	8.4
June 30, 1982	25,000,000	8,000,014	707,010	8.8
July 30, 1982	25,000,000	8,000,014	642,662	8.0
August 31, 1982	25,000,000	8,000,014	629,686	7.9
September 30, 1982	25,000,000	8,000,014	629,379	7.9
October 31, 1982	25,000,000	8,000,014	626,546	7.8
November 30, 1982	25,000,000	8,000,014	688,648	8.6

[1] As a result of a recent public offering, on December 29, 1982 the total number of shares outstanding increased by 1 million to 9,000,014. However, figures showing the distribution of shares outstanding at December 31, 1982 are as yet unavailable.

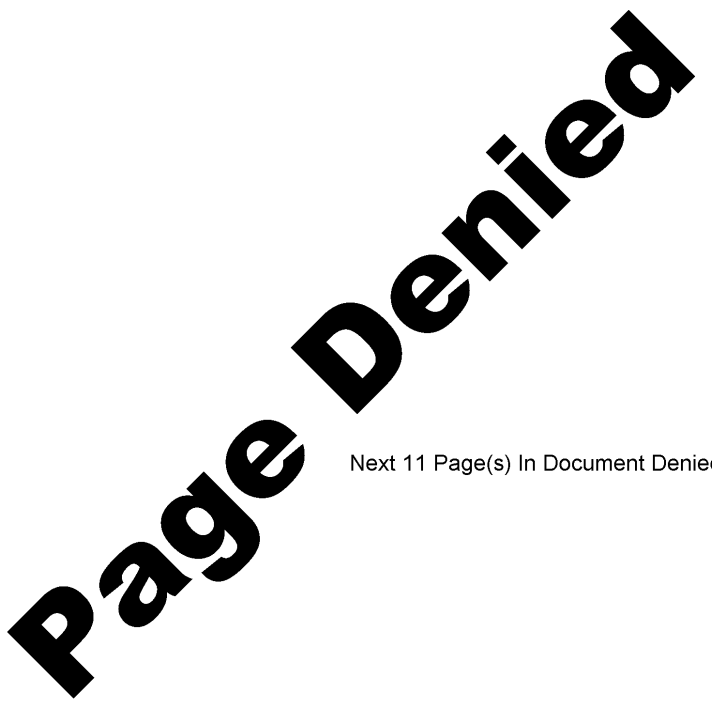

Exhibit 4
INMARSAT

MEMBER COUNTRIES, SIGNATORIES AND INVESTMENT SHARES
(as at 6 February 1985)

COUNTRY	SIGNATORY	INVESTMENT SHARE %
USA	Communications Satellite Corporation (COMSAT)	30.73445
UNITED KINGDOM	British Telecommunications plc	14.55463
NORWAY	Norwegian Telecommunications Administration	11.59239
JAPAN	Kokusai Denshin Denwa Co., Ltd.	6.95937
USSR	Morsviazsputnik	6.91198
CANADA	Teleglobe Canada	3.85104
DENMARK	Post and Telegraph Administration	2.46867
SINGAPORE	Telecommunication Authority of Singapore	2.38775
NETHERLANDS	Netherlands PTT Administration	2.27661
ITALY	Telespazio	1.94444
GERMANY, FEDERAL REPUBLIC OF	Bundesministerium fur das Post und Fernmeldewesen	1.68518
FRANCE	Direction Generale des Telecommunications	1.67224
GREECE	Hellenic Telecommunications Organization (OTE)	1.67224
KUWAIT	Ministry of Communications	1.16669
SPAIN	Compania Telefonica Nacional de Espana	1.16669
SWEDEN	Swedish Telecommunications Administration	1.10090
AUSTRALIA	Overseas Telecommunications Commission (OTC)	1.07835
BRAZIL	Empresa Brasileira de Telecomunicacoes S.A. (EMBRATEL)	0.97228
INDIA	Overseas Communications Service	0.97228
POLAND	Office of Maritime Economy	0.97228
SAUDI ARABIA	Ministry of Posts, Telegraphs and Telephones	0.97228
CHINA, PEOPLE's REPUBLIC OF	Beijing Marine Communications and Navigation Company	0.71669
BELGIUM	Regie des Telegraphes et des Telephones	0.34064
ARGENTINA	Empresa Nacional de Telecomunicaciones (ENTEL)	0.29623
FINLAND	General Directorate of Posts and Telecommunications of Finland	0.29623
NEW ZEALAND	Post Office Headquarters	0.21025
BULGARIA	Shipping Corporation	0.15765
PORTUGAL	Companhia Portuguesa Rádio Marconi	0.10732
EGYPT	National Telecommunications Organization (ARENTO)	0.07492
LIBERIA	Republic of Liberia	0.07492
PHILIPPINES	Philippine Communications Satellite Corporation (PHILCOMSAT)	0.07492
UNITED ARAB EMIRATES	Ministry of Communications	0.07492
SRI LANKA	Overseas Telecommunication Service	0.06257
ALGERIA	Ministere des Postes et Telecommunications	0.05000
CHILE	Empresa Nacional de Telecomunicaciones S.A. (ENTEL-CHILE)	0.05000
GABON	Telecommunications Internationales Gabonaises (TIG)	0.05000
IRAN	Telecommunication Company of Iran	0.05000
IRAQ	Republic of Iraq	0.05000
OMAN	Sultanate of Oman	0.05000
PAKISTAN	Pakistan Telegraph and Telephone Department	0.05000
TUNISIA	Republic of Tunisia	0.05000
		100.00000

* includes the initial investment share of Byelorussian and Ukrainian SSRs

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